



MONITORS

**14 Big-Screen
Paper-White
Display Systems
For DTP and CAD**

FIRST LOOKS

**Word for Windows:
Graphical WP Gives
Words and Pictures
Equal Billing**

CONNECTIVITY

**ISDN Roundup:
6 Great Adapters
And Why You Can't
Use Them—Yet**

FREE UTILITY

**Fortify Your System
Against Data
Corruption with
PCDATA**

VOLUME 9 NUMBER 3

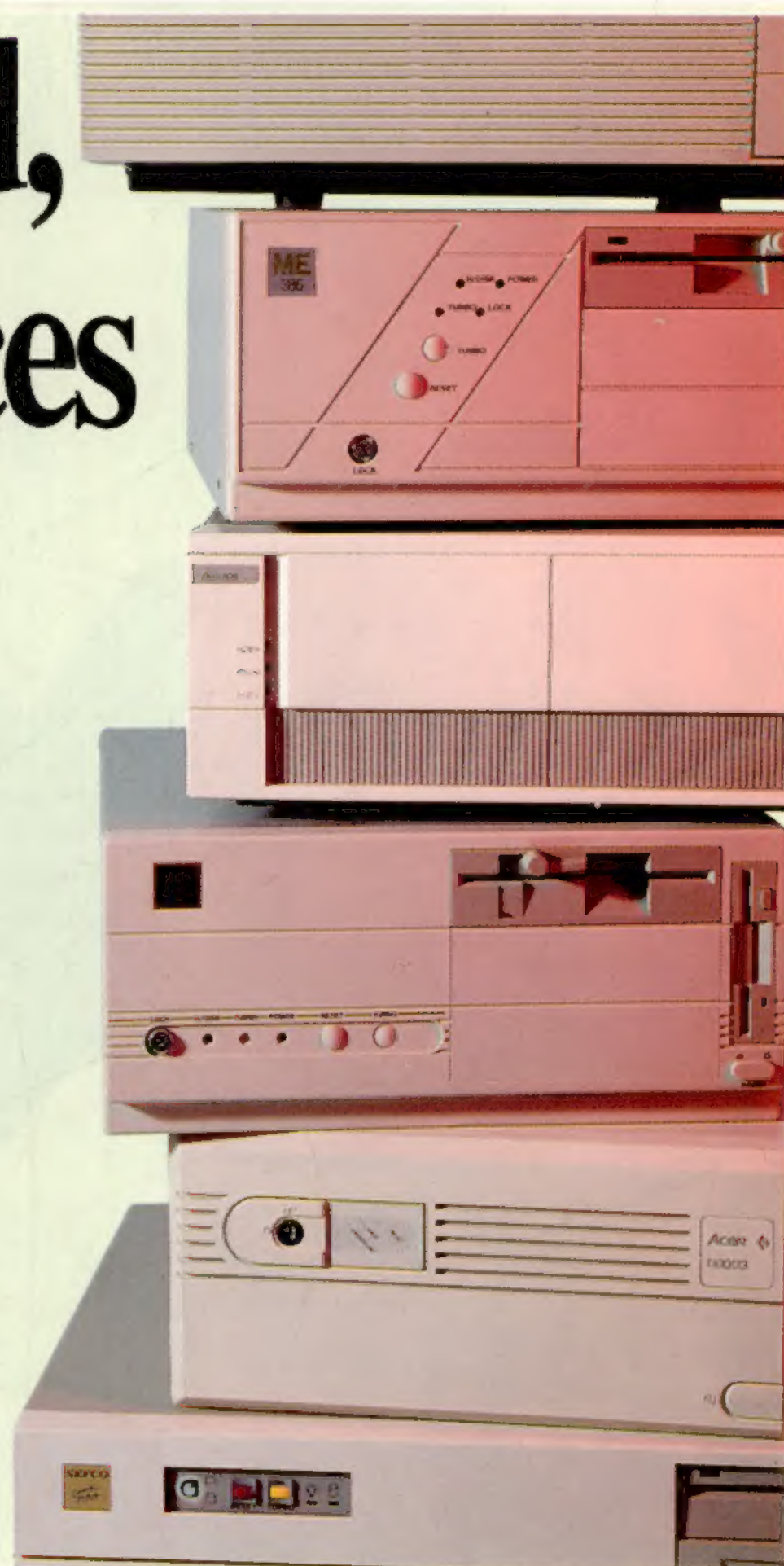
THE INDEPENDENT GUIDE TO IBM-STANDARD PERSONAL COMPUTING

FEBRUARY 13, 1990

MORE Speed, MORE Choices

PC Labs Tests
22 MORE
33-MHz 386 PCs

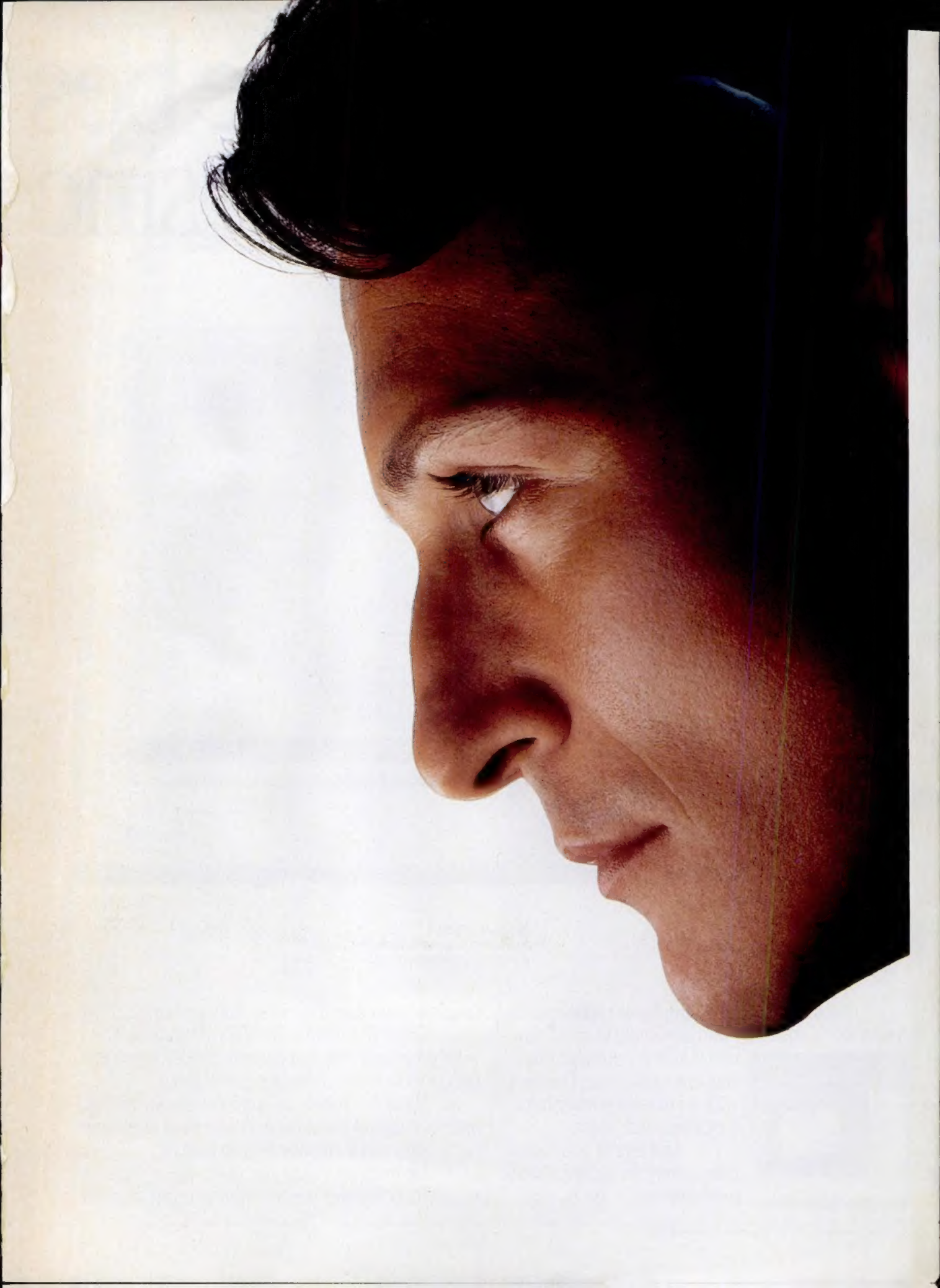
Acer 1100/33
AT&T 6386E/33 Work Group System
Blackship 386/33
C² 386/33
Club AT Model 333C
CSS MaxSys
Dataworld Data 386-33
Destiny 386-33
DTK Keen 3304
Eltech 9970
NetSet 333
HIMS Cache Pro 386/33
Micro Express ME 386-33LC
Micro 1 Power 386/33
Flash 386-33
Oak MicroSystems D386/33/4
Olivetti M380/XP9
PC Craft 5000/33C
PC Max PM 386-33/M
Spear 386/33U
Ultra-Max 386-33
Zeos 386/33



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We want you to
always view our monitors
in a certain way.



Introducing the best the office memo since

They're here...

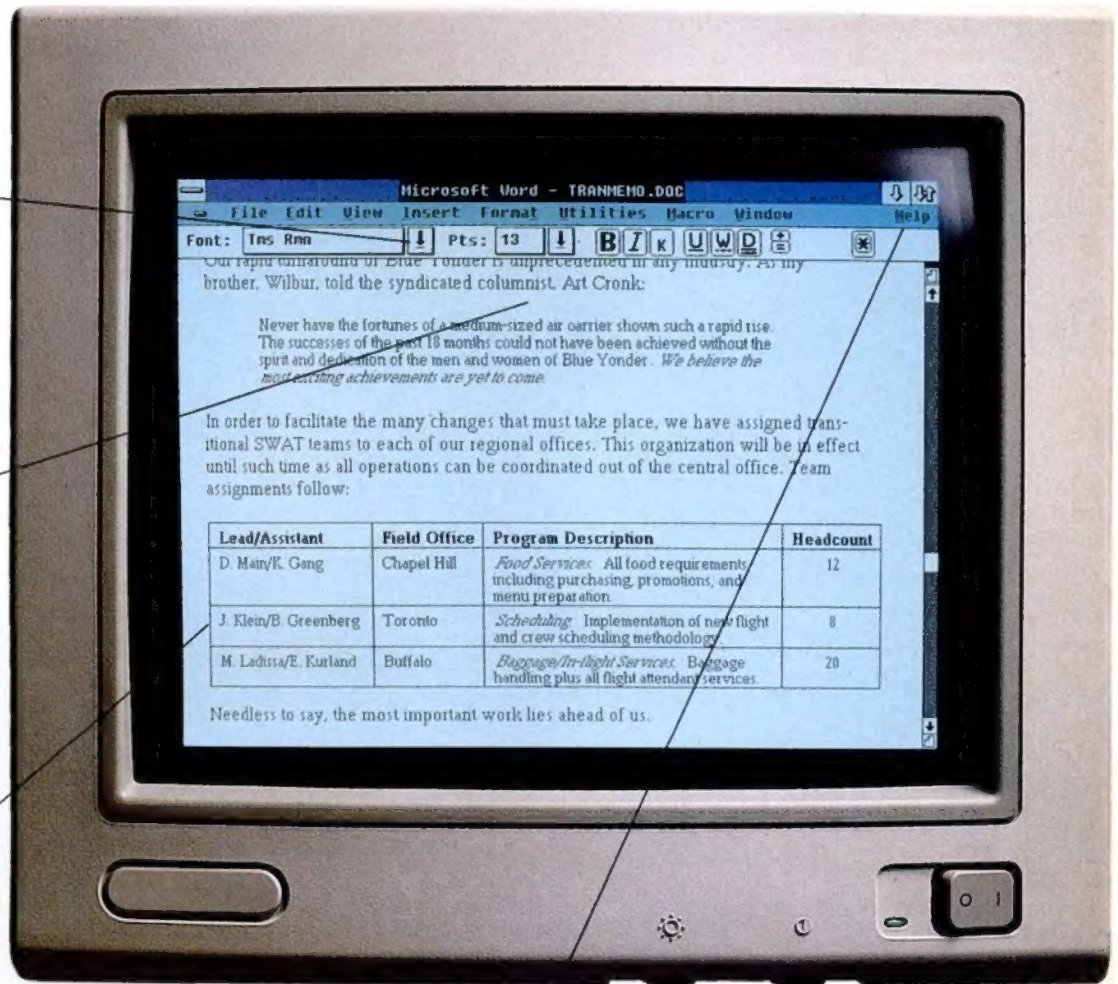
Intuitive icons on the Ribbon make those everyday tasks, like formatting, as easy as ABC. Or, more precisely, see, point, do.

Save a tree.

WYSIWYG editing shows what each page will look like, before it's printed, a feature that's easy on paper. Not to mention your patience.

We offer outstanding table service.

Now, creating a table is easier than dining out. The Word for Windows table feature allows you to organize numbers, text, and graphics in a spreadsheet-like array of cells. And there's no tab.



Help wanted.

Word for Windows context-sensitive, on-line help gets you up and running quickly. And keeps you there.

Chances are, those simple, everyday memos you've been creating aren't so simple to create anymore. What with the time-consuming process of messing with formatted paragraphs, typefaces, and tables.

And even if your documents aren't formatted, there's probably someone in your

office who wishes they were. You, perhaps.

Enter Microsoft® Word for Windows™. The word processor that compares to predecessors like the correction key compares to white-out.

Word for Windows' intuitive graphical user interface makes the most annoying and mundane parts of everyday memos as easy as ABC.

Or, more precisely, see, point, do.

Its computer-based training program and



Nothing is going to happen to me the correction key.

BLUE YONDER AIRWAYS



INTEROFFICE MEMO

To: All personnel
From: Orville Bannister
Re: Transition to passenger service
Date: November 1, 1989

Congratulations to all of you who have worked so hard over the last two years to make Blue Yonder a full-service passenger airline. The final licensing procedures were completed at 18:53 hours on October 27, authorizing us to commence passenger service immediately.

Our rapid turnaround of Blue Yonder is unprecedented in any industry. As my brother, Wilbur, told the syndicated columnist, Art Cronk:

Never have the fortunes of a medium-sized air carrier shown such a rapid rise. The successes of the past 18 months could not have been achieved without the spirit and dedication of the men and women of Blue Yonder. We believe the most exciting achievements are yet to come.

In order to facilitate the many changes that must take place, we have assigned transitional SWAT teams to each of our regional offices. This organization will be in effect until such time as all operations can be coordinated out of the central office. Team assignments follow:

Lead/Assistant	Field Office	Program Description	Headcount
D. Main/K. Gang	Chapel Hill	Food Services. All food requirements, including purchasing, promotions, and menu preparation.	12
J. Klein/B. Greenberg	Toronto	Scheduling. Implementation of new flight and crew scheduling methodology.	8
M. Ladissa/E. Kurland	Buffalo	Baggage/In-flight Services. Baggage handling plus all flight attendant services.	20

Needless to say, the most important work lies ahead of us.

Off we go!

Blue Yonder Airways, Inc. 1000 First Flight Boulevard Kitty Hawk, North Carolina 27949

Our guide will lead the way.

Document Templates give you transparent access to sophisticated features like macros, glossaries and Styles, guiding you through the creation of a document.

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Style sheets allow you to name character and paragraph formats. Then apply them quickly, easily, and most important of all, consistently. So it's simple to maintain corporate standards or establish your own.

Choose your weapon.

Word for Windows was designed with the mouse in mind, but it can be used equally well with keyboard commands.

context-sensitive, on-line help make getting started every bit as natural as using it.

In addition, Word for Windows allows you to make the quantum leap into graphical word processing without losing the equity you have in your current program. It reads and writes files from virtually all word processing applications.

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CIRCLE 280 ON READER SERVICE CARD

Inside

That's Mr. Stegosaurus to you.

To know contributing editor Alfred Poor is to understand why we photographed him with Mr. Stegosaurus. As the reviewer for the paper-white monitor/adaptor story, he understands the concept of utility, whether that applies to a stegosaurus that also functions as a tape measure, or to a complete monitor-and-card solution for all of your DTP and CAD needs.

When we planned this roundup, Alfred Poor was an obvious choice to test these multimedia systems. Unlike many computer experts, Poor has resisted the temptation to specialize in one area of the industry. He is the rare generalist who has a real depth of knowledge about a wide variety of PC topics.

"I'm interested in full systems that get the job done," says Poor. "In order to test these paper-white systems, you have to understand all the pieces to effectively evaluate the whole set—including the software, the card, and the monitor."

In the past, *PC Magazine* has often tested these products in separate roundups, but the latest in DTP and CAD technology demands a different approach. Poor explains, "Buying these pieces from separate companies is not a very efficient way of putting the system together. There are lots of ways you can cook up your own system, but we're looking for one-step solutions in a single package. The idea is to install the card,

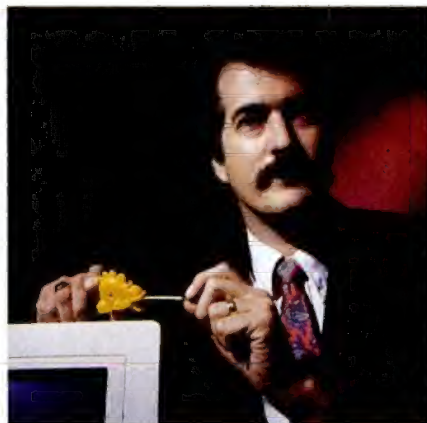


plug in the monitor, load up the drivers, and go to work."

In 1988 Poor left Soft Industries, the consulting company he founded in 1982, to go solo and structure his work life around his family life "instead of the other way around." He set up an office, affectionately termed the "Electronic Cottage," across the yard from his house in order to spend more time with his wife, Bebe, and children Anna, 11, and Alex, 8. Alex is the source of Mr. Stego-

saurus, a party favor that he knew his functionality-can-be-fun father would appreciate.

Putting a paper-white display system on top of a 33-MHz 386 can only improve your DTP or CAD life. In the October 31, 1989, issue, we examined the first 22 speed-monster 386s to hit the streets. Just a few



Contributing editor Alfred Poor holds constant companion Mr. Stegosaurus, proof positive that functionality need not be humorless.

months later, 21 new models are already biting at their heels. Not only are high-speed 386s relegating the 286 machines to the fate of the dinosaur, 386 machines are also accelerating the pace of the PC market.

The world of connectivity is making even more dramatic leaps than the world of PCs. The Integrated Services Digital Network (ISDN) has been established in a number of cities around the country, changing our notions about telephones and LANs. With six component ISDN adapters available, the future may become the present faster than you think.—Stephanie K. Losee

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PHOTOGRAPHY: THOM O'CONNOR

Experts rate QMS PostScript printers tops in every class

QMS PS-810

Although very similar to the LaserWriter IINTX, the QMS PS-810 is less expensive (\$2,004 less). The PS-810 provides comparable print quality and a parallel port, but its performance is not quite as fast as the IINTX's and it cannot be equipped with a hard disk. The PS-810's 2-megabyte base memory can be expanded to 3 megabytes, which accommodates enough fonts for most users. It can be equipped with the same 1000-sheet cut sheet feeder that fits on the QMS PS-1500, and it comes with the PS Executive Series printer utility as well. The PS-810 was the recommended printer in NSTL's last PostScript printer evaluation, and it may be an even better buy this year in view of QMS's recent price reduction.

- PC Digest Ratings Report
Vol.3, No. 4

standards.
the card was
warranty.

If you have a LaserJet Series II and need PostScript compatibility, JetScript offers a ready solution. In fact, the smooth operation and impressive speed of this controller almost justify purchasing the LaserJet just to put the JetScript card in it.

Laser Connection/QMS PS-810

S has a reputation

Steve Apike
& Stan Diehl
BYTE - 9/88

PC Magazine -
April 25, 1989

complaint.

If you're looking for a laser printer with a PostScript language controller (and the famous 35 Adobe fonts built into ROM), take a look at QMS's superb PS-810. A fast, updated LaserWriter Plus clone, the PS-810 uses the later, superior Canon SX engine and adds that missing parallel connection—plus emulations that range from HP LaserJet Plus to Diablo 630 to HPGL. I use a PS-810 on a second PC in my office and greatly admire this tough, smart machine. While it's not the sexiest of machines, it's a fair

should be ready to connect to just about any type of computer.

For high-volume desktop publishing, network situations, and other intensive PostScript applications where throughput, duty cycle, and paper capacity are issues, the QMS PS-820 is an extremely solid contender. When you add up the pros and cons and compare the PS-820 to other PostScript options, this printer looks very good indeed.

—Jon Pepper

- Jon Pepper
Personal
Computing

Congratulations. We are pleased to inform you that Macworld readers have voted QMS ColorScript 100 the 1989 World Class winner in the Color Printer category. Trophies will be awarded at our third annual World Class Awards Banquet at the Ritz-Carlton during the Macworld Expo Boston. We would like to thank you for your support.

- MacWorld

QMS PS-1500

The QMS PS-1500 combines exceptionally fast performance and high-volume paper capacity. Features include a comprehensive control panel, 4 megabytes of base memory, and 35 internal font outlines. The PS-1500's unique PS Executive Series utility lets users print an advanced status page, download an error handler, and print screens. The PS-1500 can be equipped with a 1000-sheet cut sheet feeder and an external hard disk. The PS-1500's list price of \$7,995 makes it more economical for users with high-volume printing needs.

PC Digest
Ratings Report -
Vol.3, No. 4

QMS offers more Adobe® PostScript® printing solutions in more ways than any other company. And the products we offer continually receive high ratings from industry experts.

That's not surprising when you stop to consider that QMS was one of the first companies to adopt this versatile page description language as a standard.

Today, our expertise in applying PostScript solutions is second to none, enabling us to offer products

to users who need maximum performance and productivity. Which is why experts say QMS® PostScript products continue to set the pace for the rest of the industry.

So for expert guidance to the PostScript printing solution that fits your needs, call 1-800-631-2692, extension 232

In Alabama call (205) 633-4300.

Product	Print Speed	Max. Paper Size
QMS-PS® 810	8 ppm	8.5" x 14"
QMS-PS 810 Turbo	8 ppm	8.5" x 14"
QMS-PS 820 Turbo	8 ppm	8.5" x 14"
QMS-PS 1500	15 ppm	8.5" x 14"
QMS-PS 2200	22 ppm	11" x 17"
QMS ColorScript™ 100 Model 10	1 ppm	8.5" x 14"
QMS ColorScript 100 Model 30	1 ppm	11" x 17"
PS Jet™ (controller)	NA	NA
JetScript™ (controller)	NA	NA



QMS, Inc., One Magnum Pass, Mobile, AL 36618

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CIRCLE 259 ON READER SERVICE CARD

UP FRONT

- 4 INSIDE**
- 15 LETTERS**
- 27 ADVISOR**
Lori Grunin/ Finding file formats; music-sequencing software; equation-generating word processors.
- 33 FIRST LOOKS**
Word for Windows brings information management technology to word processing.
Microsoft BASIC Professional Development System: Once a teaching tool, now a full-fledged application-building platform.
Zenith's Z-386/33E: Reasonably priced EISA machine is strong on network disk support.
Okidata's OkiLaser 400, packing 17 internal fonts, enters the low-priced page printer fray.
WordPerfect 5.1 adds pull-down menus, mouse support, tables, and an equation editor.
Drafix Windows CAD 1.0: The first 2-D CADD product to run under *Windows*.
- 53 NEW AND IMPROVED**
Alan Cohen
- 63 PIPELINE**
Gus Venditto
- 67 BILL MACHRONE**
The new Big Blue.
- 73 JOHN C. DVORAK**
The trouble with Comdex.
- 75 Inside Track**
- 79 JIM SEYMOUR**
The "because we could" syndrome.
- 83 WILLIAM F. ZACHMANN**
Mainframe machismo.
- 91 STEPHEN MANES**
CD-ROM data standards at last.



COVER STORY

- 97 COMPUTERS**
Speed to Burn: 22 of the Fastest 386s
Alfred Poor/ When it comes to 386 power, the 33-MHz 386 can't be beat. If you thought your choices in this young product category were limited, think again—the market is flooded with offerings. In our second look at top-of-the-line 386s, PC Labs tests 22 newcomers, from Acer to Zeos.
- 99 Acer 1100/33**
- 100 AT&T 6386E/33 Work Group System**
- 100 Blackship 386/33**
- 109 C² 386/33**
- 117 Club AT Model 333C**
- 118 CSS MaxSys**
- 120 Dataworld Data 386-33**
- 120 Destiny 386-33**
- 132 DTK Keen-3304**
- 132 Eltech Model 9970**
- 142 NetSet 333**
- 145 HIMS Cache Pro 386/33**
- 145 Micro Express ME 386-33LC**
- 146 Micro 1 Power 386/33**
- 148 Flash 386-33**
- 150 Oak MicroSystems D386/33/4**
- 150 Olivetti M380/XP9**
- 153 PC Craft 5000/33C**
- 154 PC Max 386-33/M**
- 154 Spear 386/33**
- 156 Ultra-Max 386-33**
- 157 Zeos 386/33**
- 102 Features Table**
- 125 Performance Tests**
- 156 Editor's Choice**

FEATURES

- 161 MONITORS**
Now Showing on the Big Screen . . .
Alfred Poor/ DTP and CAD users are looking for a total solution to their paper-white display needs, and the answers are here. PC Labs tests 14 monitor-and-adaptor systems with screens measuring 19 inches or greater. Whether you're looking for gray scaling or low price, we take the guesswork out of buying your paper-white hardware.
- 164 Cornerstone Technology**
- 166 Elite Business Applications Inc.**
- 177 Image Systems Corp.**
- 177 Micro Display Systems Inc.**
- 178 Moniterm Corp.**
- 187 Panasonic Communications and Systems Co.**
- 190 Sampo Corp. of America**
- 208 Sigma Designs**
- 217 Taxan USA Corp.**
- 217 Ventek Corp.**
- 220 Wyse Technology**
- 222 Xerox Corp.**
- 194 Features Table**
- 168 Performance Tests**
- 226 Editor's Choice**



FEATURES

229 CONNECTIVITY

Building Network Solutions: Is ISDN Tomorrow's Interoffice Network?

Frank Derfler/ Integrated Services Digital Network is available in several areas of the U.S., but it has a long way to go before it is crowned tomorrow's phone system. We evaluate six adapters that could bring digital telecommunications to your home or office.

242 Features Table

PRODUCTIVITY

263 UTILITIES

Protect Your Data with PCDATA, the Data Integrity Toolkit

Wolfgang Stiller/ Guard your computer against all kinds of corruption. Whether the problem turns out to be the smallest software bug or the most sophisticated virus, this issue's utility can restore your system.

285 ENVIRONMENTS

Printing Under the OS/2 Presentation Manager, Part 1

Charles Petzold/ OS/2 introduces the device-independent interface, which handles the output of text and graphics whether they are sent to a video display or a printer.

297 POWER PROGRAMMING

Arithmetic Routines for Your Computer Programs, Part 6

Ray Duncan/ This installment presents you with specific arithmetic programming tips that will help you make the most of your coprocessor.

311 SPREADSHEETS

Craig Stinson/ Find out how to mix text and formulas in 1-2-3 graph titles, generate graphs with error bars, and more.

335 Direct Marketing Connection

354 Marketplace

376 Advertisers' Product Index

378 Editorial Product Index

379 Reader Service Card

381 Coming Up

382 Showcase

385 Index to Advertisers

PRODUCTIVITY

315 USER-TO-USER

Neil J. Rubenking/ Use ordinary DOS programs to detect changes in your hard disk's boot sector; convert ERRORLEVEL into an environment variable; control loop operations in a batch file with COUNTER.COM.

319 POWER USER

Craig L. Stark/ Changing outline headings with *Microsoft Word*; comparing two documents in split-screen with ALTG.WPM.

323 LANGUAGES

Tony Rizzo/ Play the piano on your computer—here's a Turbo Pascal routine that simulates the BASIC PLAY statement.

327 TUTOR

Jeff Prosis/ What does your PC do from the time you turn on the power until the DOS prompt appears? Here's a look at what happens during the POST (Power On Self Test).

333 CONNECTIVITY

Frank J. Derfler, Jr./ Interrupt conflicts can disrupt communications; automate checking your mailbox; a device that lets you use multiple CPU cards and a board that contains multiple modems; the surprising results of our survey that asked users for a week's worth of data on server activity.

AFTER HOURS

383 ■ *The Playroom* lets youngsters set their own learning agenda.

■ Print attention-getting signs and banners with *BannerMania*.

■ *WealthBuilder* shows you the way to financial security.

■ *Hostage* puts you in charge of an antiterrorism squad.

388 ABORT, RETRY, FAIL?

Bill Howard





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PC MAGAZINE REVIEWS

Except where noted: All *PC Magazine* reviews are of currently available products. Comparative reviews are arranged alphabetically by product name for software, by company name for hardware. Software is free from copy protection. On benchmark test charts, shorter bars indicate faster products (less time to complete a task). Benchmark and performance tests are run on 8-MHz IBM PC ATs.





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Letters

CALLING ALL PRINTERS

Because I am actively in the market to purchase a laser printer, I picked up your recent printer blockbuster issue (*PC Magazine*, November 14, 1989). Much to my surprise, I discovered that three of the manufacturers I am most interested in—Kyocera, Panasonic, and Toshiba—were not included in your reviews. These manufacturers had laser printer models available when your tests began in May.

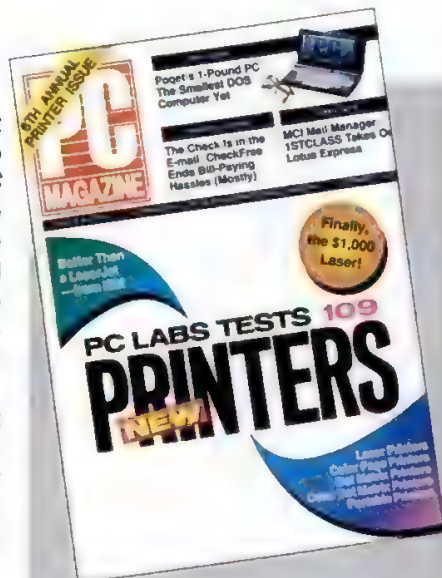
I realize you depend on equipment being contributed by the manufacturers. Yet these companies are certainly better known, better advertised, better selling, and more widely available than many covered in the review.

Michael K. Bergman
Hamilton, Montana

PC While it is true that laser printers from Kyocera, Panasonic, and Toshiba were available at the time we began our testing process, these units were essentially identical to models reviewed in past printer roundups. Please see "The *PC Magazine* Printer Index (1984-1989)" on page 383 of the November 14, 1989 issue for the details on each model, and the date of the original review.

PC Magazine's November 14, 1989, issue on printers contained a sidebar on pages 180 and 181 entitled "LaserMaster 1000: Typesetter-Quality 1,000 by 400 dpi." The article stated that the *WordPerfect* driver for this printer was limited to 400 by 400 dpi. This is not completely true. *WordPerfect* offers a 1,000 by 400 dpi driver for the LaserMaster 1000 and its controller card with more than 200 fonts in portrait orientation. This driver may be ordered by calling (801) 225-5000. In *WordPerfect* 5.1 there will be support for both portrait and landscape orientations at 1,000 dpi.

Terry DeFreese
PC Printing
WordPerfect Corp.
Urem, Utah



Our 1989 printer issue was one of the most popular this year.

GUI INDIGESTION

With respect to the letter from Diana G. Matthiesen (Letters, *PC Magazine*, November 28, 1989), I couldn't have stated the case against graphical user interfaces more succinctly.

Those people pushing GUIs are, in effect, saying that we are a nation of illiterates, and if I read one more statement to the effect that all programs should "look and feel alike" I may throw up.

I, too, am a touch-typist, having set a record in high school of 143 wpm that still stands over 30 years later, and will not use anything that slows me down. Furthermore, as DP Manager at an 80 million dollar company, I will not allow GUIs in the workplace, period. In fact, my subordinates have been told that if I ever have occasion to turn on one of their PCs and find myself confronted with icons, they will be fired immediately.

It is perfectly possible to design user-friendly software that is function-key driven from the command line. Software developers should take note.

John Boots
Jacksonville, Florida

SO FUNNY I FORGOT TO LAUGH

I write to magazines every once in a blue moon, but your apparent lack of editorial judgment has driven me to pick up my pen. I refer to Stephen Manes' column in the November 14, 1989, issue of *PC Magazine*. What on earth was this doing in a computer publication? A column about some writer whining about his supposedly funny and interesting day? I buy *PC Magazine* to read about technology, not editorial whimpering. Manes should save this drivel for happy hour with his writer buddies. And you should have killed this feeble stuff, and replaced it with an ad.

Ryan Castinado
Sylmar, California

HAND-ME-DOWN PCs

A quick comment on John C. Dvorak's column entitled "The Myth of the Replacement Market" (John C. Dvorak, *PC Magazine*, November 14, 1989). As chief of the Information Management Division at a large Army hospital, I am constantly approached by people who want to know what kind of personal computer they should purchase. After asking the two "big" questions ("How much do you want to spend?" and "What do you want to do with your PC?"), I then try to point them in the right direction.

The majority of these folks are not replacing current machines, but are becoming the entry-level owners of whom Mr. Dvorak speaks. My recommendations have run the gamut from desktops to laptops, from 8088's to 80386's, but the new purchaser is definitely out there. I myself am a contributor to the "trickle-down distribution chain," having sold my 8088 machine (which I bought several years ago after passing my Commodore 128 to my son), and having loaned my "obsolete" Epson CP/M laptop to a college student (who is thrilled to have it).

I have no doubt that the purchaser of my 8088 will eventually replace it with a hotter machine, and that the college student will join the ranks of computer owners after his graduation. It is absurd to even

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Letters

suggest that the base of PC purchasers is stagnant. You are right on the money, John.

Robert Neville
Augusta, Georgia

My eyes froze in their tracks when I read the following phrase in John C. Dvorak's column about the replacement market: "most of these machines go to new 'entry-level' owners: wives, children..." I am a woman with more technical knowledge than my spouse, and I have noticed that it is very difficult for most people to accept that a wife can be a more experienced and technical user than her husband. I am not so surprised that this phrase reflects Mr. Dvorak's thinking but I am appalled that the editor who reviewed his column did not point the issue out and try to make it less offensive.

Those of you who are in charge of technical publications must realize that the work force is changing, and your female readership is steadily growing. We welcome editorial content that doesn't exclude us or, as in this case, relegate us to secondary status.

Amy Christian
Ithaca, New York

DIFFERENCE OF OPINION

Jim Seymour's assertion in his November 28, 1989, column that "Today, there is no defensible reason for buying an 80286-based desktop PC for use in business" is the kind of techno-babble that we're all tired of hearing.

If I look around at our corporation, I find that the vast majority of machines in use are dedicated to low power tasks (e.g., word processing, spreadsheets). And 286 PCs are handling those applications very well. Why should I believe that within the next three to five years the *business needs* of the people using these machines will change? Will my secretary want or need a graphical interface? Do I want to pay for that option? The bottom line is that here may be software coming which needs a 386, but to assume that all of the places into which business puts PCs need that software is absurd. If any consultant displayed that attitude to me, I'd show him the door.

Larry Bloom
Tampa, Florida

As a systems professional in charge of the design and development of Application Specific Software, which my company markets for IBM PC and PS/2 and compatible computers, I feel that I probably represent the typical *PC Magazine* reader—one who dutifully scours the many industry publications hoping to pick up the faintest scent of future trends.

In his November 28, 1989, column, William F. Zachmann argued that, in effect, OS/2, together with the 386 computer shall soon inherit the earth. And while I'm sure Mr. Zachmann will receive a torrent of hate mail for expressing this seemingly unpopular opinion, I, for one, agree with his assertion.

I believe that OS/2 running on a 386 or even 486 machine will probably become the mainstay of the industrial and commercial user base. I believe that it will become the standard for serious hobbyists, as well. There is just too much to be gained for the industry to stall at DOS's limits.

As all the applications I produce today are DOS-based, I probably have more reason than anyone to wish that an OS/2 migration wasn't coming. But nonetheless, coming it is.

John P. Berting
Piscataway, New Jersey

There seems to be a difference in the perception of the "corporate" personal computer market between your staff and myself as an end-user in a multinational division of a Fortune 100 corporation. A recent example of this is William F. Zachmann's column in the November 28, 1989, issue of *PC Magazine*.

Zachmann's implication that "many users already have 386 systems with 100MB hard disk capacity and 4MB or more of memory" is not typical of a system in our environment. The high-end application on our PC-based systems is computer-aided design, and we have been extremely productive with machines ranging from 8-MHz ATs to 16-MHz 386 clones. All of these systems contain around 1MB of memory and EGA graphics. In fact, I get along just fine with my trusty AT.

We really enjoy your magazine and look forward to reading all the latest product reviews and editorials, but your perception of the "real world" seems to deviate farther from ours with each and every issue.

William C. Easterday
Elyria, Ohio

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Letters

MACRO PERFECT

My compliments to Neil J. Rubenking on his article "WordPerfect Offers a Bona Fide Programming Environment" (Lab Notes, *PC Magazine*, October 31, 1989). His exploration of macro commands was more thorough than I will ever need, and was easily understood as well.

I have always been a big *WordPerfect* fan and have a lot of respect for the creators of the program. It's a shame their manual leaves so much to be desired. Thanks to articles like Mr. Rubenking's, I can use the program to a much fuller degree.

Greg Golden
Van Nuys, California

BASIC INFORMATION

Thank you for a fine article on the state of BASIC ("BASIC, Yes; Feeble, No," *PC Magazine*, October 31, 1989). You demonstrate conclusively that BASIC has regained for itself a viable place in the application development market.

But while AJS Publishing was privileged to be mentioned in your sidebar "Building on the BASIC Foundation" (page 190), readers who wished to further investigate how our *db/LIB Database Library* manages *dBASE*-type files were left on their own to find our address and telephone. They may contact us at P.O. Box 83220, Los Angeles, CA 90083; (800) 992-3383 or (213) 215-9145 in California.

db/LIB now works with *Microsoft QuickBASIC* 4.0 and 4.5, as well as with *Microsoft BASIC* 6.0. A LAN version is also available.

Jim Taylor
President, AJS Publishing
Los Angeles, California

X MARKS THE SPOT

Recently, I've noticed several billboards around the Houston area that show the number "286" marked out by a big red X. In small letters on the bottom right of the sign is the word *Intel*. This tells me that the boys at that company are turning their backs on one of the most popular processors to ever hit the PC market.

Perhaps they should talk to the OS/2 people at IBM about "biting the hand that feeds."

David Waldrop
Houston, Texas

There may be software
coming that needs
a 386, but to assume
that everyone in
the office needs that
software is absurd.
If any consultant
displayed that
attitude to me, I'd
show him the door.

PC EDUCATION

You might be interested in hearing about a unique use to which we have put *PC Magazine*. I teach an Advanced Microcomputer Applications course for which, of course, there is no suitable textbook. So we have decided to use *PC Magazine* as our main reference. The course is taught on both the graduate and undergraduate levels and is, I believe, very popular with the students.

Now if only we could get a reduced rate subscription!

Professor Y. Langsam
CIS Department
Brooklyn College
Brooklyn, New York

CORRECTIONS & AMPLIFICATIONS

Contrary to what was reported in the accompanying features table, "Two Aces and a King: The Big Three Word Processors Raise the Ante," (*PC Magazine*, November 28, 1989), *Microsoft Word* does print blocks of text.

HOW TO WRITE TO PC MAGAZINE

Send letters to *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). All letters become the property of *PC Magazine* and are subject to editing.

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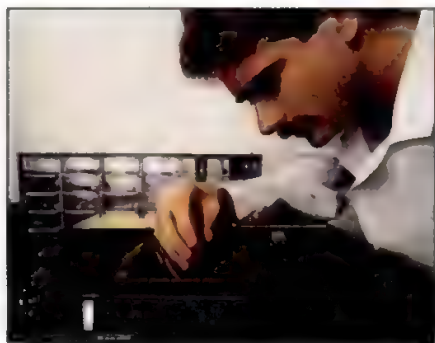


Here's Your Team

1 Our tour starts outside our building with most of our over 90 employees greeting you. We moved into this custom designed facility last Spring. We're starting our 7th year in State College, PA, also the home of Penn State University. In fact, many of our employees have ties to the school.

Careful Selection Means Top Quality Components

2 Our first stop inside is our large Product Development Lab. Here, engineers are testing 486 systemboards, so we'll be ready early for the next generation of chips when they're available. We evaluate components from all major manufacturers, with particular emphasis on compatibility, reliability and performance. We evaluated eight systemboards for the new SWAN 33 MHz 386. The only one that met our rigorous standards was from Micronics. In a recent evaluation, PC Week called them the "Cadillac of boards evaluated".



State-of-the-Art Assembly & Test Operations For Reliable Performance

3 The heart of Swan is this large, sectioned off area, the Computer Assembly and Testing Center. To prevent component damage from static electricity, the entire area and all of the people in it are grounded by an elaborate network of special floormats and wires.

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4 After assembly, each system is tested on our burn-in rack for at least 72 hours. During that time, we test all components under load conditions far higher than you will ever encounter. We only ship systems that make it through all three levels of testing.



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6



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We sincerely hope this tour has helped you. If you're one of the thousands who already do business with us, it should make us a little more familiar and friendly to you. If you haven't yet tried us, we hope your visit will convince you to order your computers, software or peripherals from SWAN. All of us in the SWAN family are dedicated to providing you the best value for your computing dollar—great prices, high performing and reliable computers, backed by superior service.

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FX-1050 (264cps, 132 col, 9-pin)	Best
LQ-510 (180cps, 80 col, 24-pin)	Price
LQ-850 (264cps, 80 col, 24-pin)	on
LQ-950 (264cps, 110 col, 24-pin)	Epson
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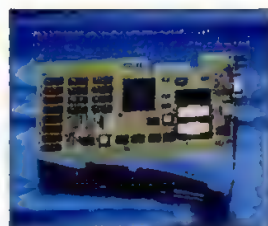
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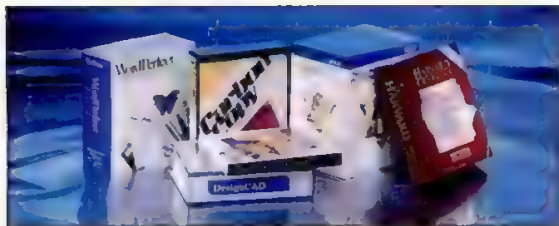
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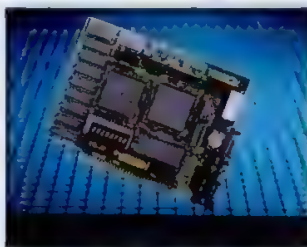
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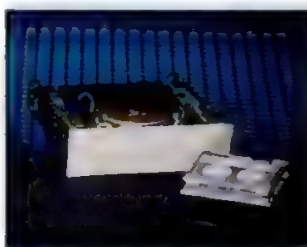


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by Lori Grunin

Advisor

DECODING FILE FORMATS

I am a programmer who needs to obtain the file formats of some popular software programs, like *dBASE* and *Lotus 1-2-3*, in order to write routines to import them. What books can you recommend that document the file structures of these and other packages?

Ng Kek Wee

Toa Payoh, Singapore



I found two books that should be of some use. Jeff Walden's *File Formats for Popular PC Software: A Programmer's Reference* (\$24.95; 1986; ISBN 0-471-83671-0; John Wiley & Sons, 605 Third Ave., New York, NY 10157; (212) 850-6000) explicates several formats, such as *dBASE* and *Lotus 1-2-3*, but hasn't been updated in three years. A more recent book, *Lotus Worksheet File Formats: Essential Data File Facts About 1-2-3, Symphony and Jazz* (\$19.95; ISBN 0-201-16824-3; Addison-Wesley Publishing Co., Jacob Way, Reading, MA 01867; (800) 447-2226, (617) 944-3700) discusses only Lotus formats.

For other formats, I suggest writing to the companies that originated them and see if they're willing to part with the information. Be careful, since there are several flavors of formats such as TIFF and PCX. In some cases you won't be able to get the format because the company wishes it to remain proprietary.

MAKING MUSIC

I have become familiar with a software package for the Atari called *Notator*—in addition to the friendly and clear graphics, it combines both sequencing and notation/printing functions.

However, I do not want to buy a whole Atari system; is there any music software package that has the features of *Notator* (including mouse support and pull-down menus) but is compatible with PCs?

Peter Jaspan

Kensington, Johannesburg

South Africa

■ **DECODING FILE FORMATS:**
Locating file-format specifications for popular packages.

■ **MAKING MUSIC:**
Sequencing and notation software for the PC.

■ **TECHNICALLY SPEAKING:**
Word processors that generate equations fit for a dissertation.



If you're really wedded to the idea of a combination package, look into *Personal Composer System/2* (\$595; Personal Composer, 2448 76th Ave. SE, Mercer Island, WA 98040; product information, (206) 236-0105 between 12 P.M. and 2 P.M. Pacific time; orders, (800) 446-8088, 9 A.M. to 5 P.M. Pacific time). By the time you read this, Version 3.0 should be out; it offers the mouse support and drop-down menus you're seeking. Version 3.0 also adds support for standard MIDI file formats 0 and 1.

For packages that do the job separately, check out *CakeWalk*, Version 3.0 (\$150; Twelve Tone Systems, P.O. Box 226, Watertown, MA 02272; (617) 924-7937) or Voyetra Technologies' *Sequencer Plus Mark III*, Version 3.0 (\$349; 333 Fifth Ave., Pelham, NY 10803; (914) 738-4500), both of which earned an Editor's Choice when we last reviewed MIDI sequencing and notation software (see "A MIDI Musical Offering," on page 229 of the November 29, 1988, issue of *PC Magazine*). Twelve Tone Systems also offers the more sophisticated *CakeWalk Professional* (\$249), which incorporates a built-in application language.

Software in the notation market ranges

in price from about \$250 to \$1,000. Included at the low end are *The Copyist II* (\$249; Dr T.'s Music Software, 220 Boylston St., #306, Chestnut Hill, MA 02167; (617) 244-6954), which can import files from many sequencing packages, and *Music-Printer Plus* (\$395; Temporal Acuity Products Inc., Bldg. 1, #200, 300 120th Ave. NE, Bellevue, WA 98005; (206) 462-1007. See After Hours in the March 28, 1989, issue of *PC Magazine*). High-end *Score* (\$995; RolandCorp U.S., 7200 Dominion Circle, Los Angeles, CA 90040; (213) 685-5141) isn't the easiest package to learn, but it produces high-end output.

In addition, I feel I should point out something you may not realize: unlike Atari computers, PCs don't have MIDI capabilities built in. So in addition to buying the software of your choice, you'll also need to purchase an MPU-401 compatible MIDI interface for your machine. Among the companies that sell interfaces are Roland (see address above); Music Quest (2504 Ave. K, #500-492, Plano, TX 75074; (214) 881-7408); Voyetra Technologies (see address above); and Computer Music Supply (382 N. Lemon Ave., Walnut, CA 91789; (800) 322-MIDI, (714) 594-5051). Each company sells a few different versions of the interface, ranging from no-frills models to the extremely sophisticated and flexible.

We've never looked at MIDI interfaces, so I have no reviews to refer you to. If you want some real-world advice and are a CompuServe member, however, you can drop in on the MIDI forum (GO MIDI) for advice. You can also find demos of *CakeWalk* and *Sequencer Plus Mark III* in data library 13 on MIDIFORUM. Closer to home, you might want to check your area for MIDI user groups.

TECHNICALLY SPEAKING

I am a student in mechanical engineering and am about to finish my doctoral thesis. Unfortunately, I cannot find a word processor or DTP program that will let me create complex equations. I used to use Lifetree's

Advisor

Volkswriter Scientific, but its printer support is outdated. I have heard of *TeX*, but I have never tried it. Please suggest some software that supports both dot matrix and laser printers.

Jae Kyung Shim
New York, New York



Luckily, you've got a lot more options now than you would have had a year ago. Although *PCTeX* (the PC version of *TeX*) can output typeset-quality equations, you probably don't want to use it. *PCTeX* works like old mainframe programs such as *RUNOFF*: you embed formatting commands and equations into your word processing document and then compile it using *PCTeX*. You probably don't need typeset-quality output, and there are far easier and more elegant solutions currently available.

If you want to minimize the time spent learning a package, check out *Total Word*, a grown-up version of *Volkswriter Scientific* (\$495; Volkswriter Inc., 411 Pacific

St., #315, Monterey, CA 93940; (408) 373-4718). It has many of the features that *Volkswriter Scientific* lacks, such as footnoting and advanced formatting controls, which can be as important to writing your dissertation as equation generation. *Total Word* was our Editor's Choice the last time we reviewed scientific word processors (see "Scientific Word Processors: Formulas for Success," on page 251 of the July 1988 issue of *PC Magazine*).

A lot has changed since our last survey of this product category, however. If you're willing to make a clean break from the past, then you might want to go with *WordPerfect*, Version 5.1 (\$495; WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; (800) 321-4566, (801) 222-5500)—the state of the art for combining word and equation processing.

You type equations the way you'd say them aloud; for instance, to produce an Å, you type A HAT. The top part of the screen shows you a WYSIWYG representation of the equation. It's extremely easy to use, and you can get nice output relatively quickly.

Nor do you need any special font sets to produce technical output; if *WordPer-*

fect can't find a symbol in the typeface you're using, it creates a bitmap of it (for any non-daisy wheel printer).

Although *WordPerfect*'s list price is the same as *Total Word*'s, most universities sell *WordPerfect* at a very steep academic discount, for which you probably qualify. If you're interested in *WordPerfect*, contact the academic computing center at your school for information about the discount availability. Make sure that you specify Version 5.1 or later, since the advanced equation-creation capabilities were added in that iteration.

For a review of Version 5.0, see "Two Aces and a King: The Big Three Word Processors Raise the Ante," on page 97 of the November 28, 1989, issue of *PC Magazine*. It doesn't discuss equation handling, but it can give you a better sense of *WordPerfect* as a word processor.

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). Please specify your equipment. ■

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First Looks

Hands-on Reviews of the Latest Products

Word for Windows Combines WP with Information Management Technology

HANDS ON
by John Dickinson

Microsoft Windows has metamorphosed from an environment with little to offer word processing users into one providing rich, competitive technology in that area. First came Samna with Ami, then *Ami Professional*, and now there's *Microsoft with Word for Windows*. It's arguable that Microsoft should have been the first to enter the fray, but tardiness doesn't matter now. What matters is that *Word for Windows* is

a better product than anyone expected it would be.

Changing word processors is not something most people readily do, and a shift from DOS to a graphical environment like *Windows* can make that move even less attractive. But *Word for Windows* is so powerful, and its new tools so useful, that it may change the way you think about word processing, including what you think a word processing program is and what a document ought to be, look like, and do.

Word for Windows is, first of

all, a yeomanlike word processor that will stand tall with the best of the breed. Whatever your business or personal word processing needs, *Word for Windows* will accommodate them well. That goes for everything from writing an ordinary letter or report to publishing a newsletter that has multiple, ruled columns and embedded graphics; it also includes using data hotlinked from other *Windows* applications.

If you're a seasoned word processing user, you won't have

CONTINUES ON PAGE 35



FEBRUARY 13
REVIEW INDEX

Zenith's Z-386/33E

First EISA PC is strong on disk caching 38

OkiLaser 400

\$1,395 page printer offers 17 internal fonts, two paper paths 43

WordPerfect 5.1

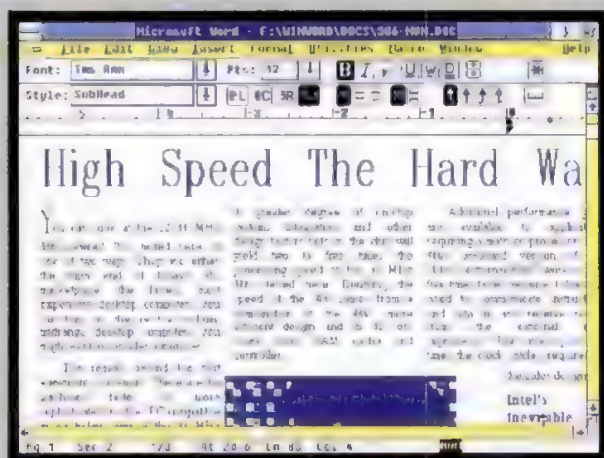
New version adds pull-down menus, mouse support, equation editor, and more 44

Drafix Windows CAD

Uses graphical environment, costs a fraction of *AutoCAD* .. 46

Move'em

Brings advanced memory management to 8088s, 80286s 48



The Ribbon at the top of the screen and the Ruler just below it provide quick access to *Word for Windows'* character- and paragraph-formatting features. Clicking on designated buttons of the Ribbon will add such attributes as bold, italics, and superscript.

Microsoft BASIC PDS: Suited for Business App Development

HANDS ON
by Salvatore P. Ricciardi

If BASIC is burdened with a reputation that portrays it as just a learning tool, the \$495 Microsoft BASIC Professional Development System (PDS, or more commonly, BASIC 7.0) is likely to alter that perception. Microsoft has created a BASIC language product that is well

suited to the development of many kinds of business applications.

Microsoft BASIC PDS addresses two main issues: allowing programmers to expedite the development of business applications through the addition of more language features and tools, and letting them create larger programs and smaller,

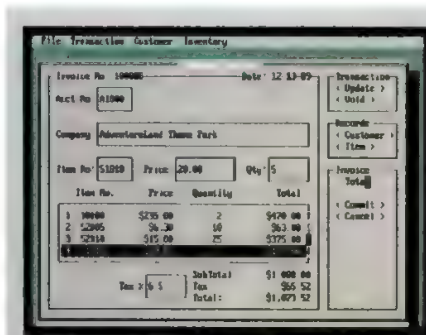
CONTINUES ON PAGE 34

First Looks

Microsoft BASIC

CONTINUED FROM PAGE 33
faster executables.

For starters, BASIC 7.0 includes a fully integrated ISAM (Indexed Sequential Access Method) data management system. Unlike third-party products that supplement BASIC with add-on libraries and a CALL-level interface, Microsoft Professional ISAM is fully integrated with the BASIC language. For example, you open



Microsoft BASIC PDS's Integrated ISAM support makes it easier to write business applications.

an ISAM file using BASIC's familiar OPEN statement (FOR ISAM). BASIC language statements such as INSERT and RETRIEVE perform common

ISAM functions, and statements like MOVENEXT and MOVEPREV position the current-record pointer.

An ISAM database can in-

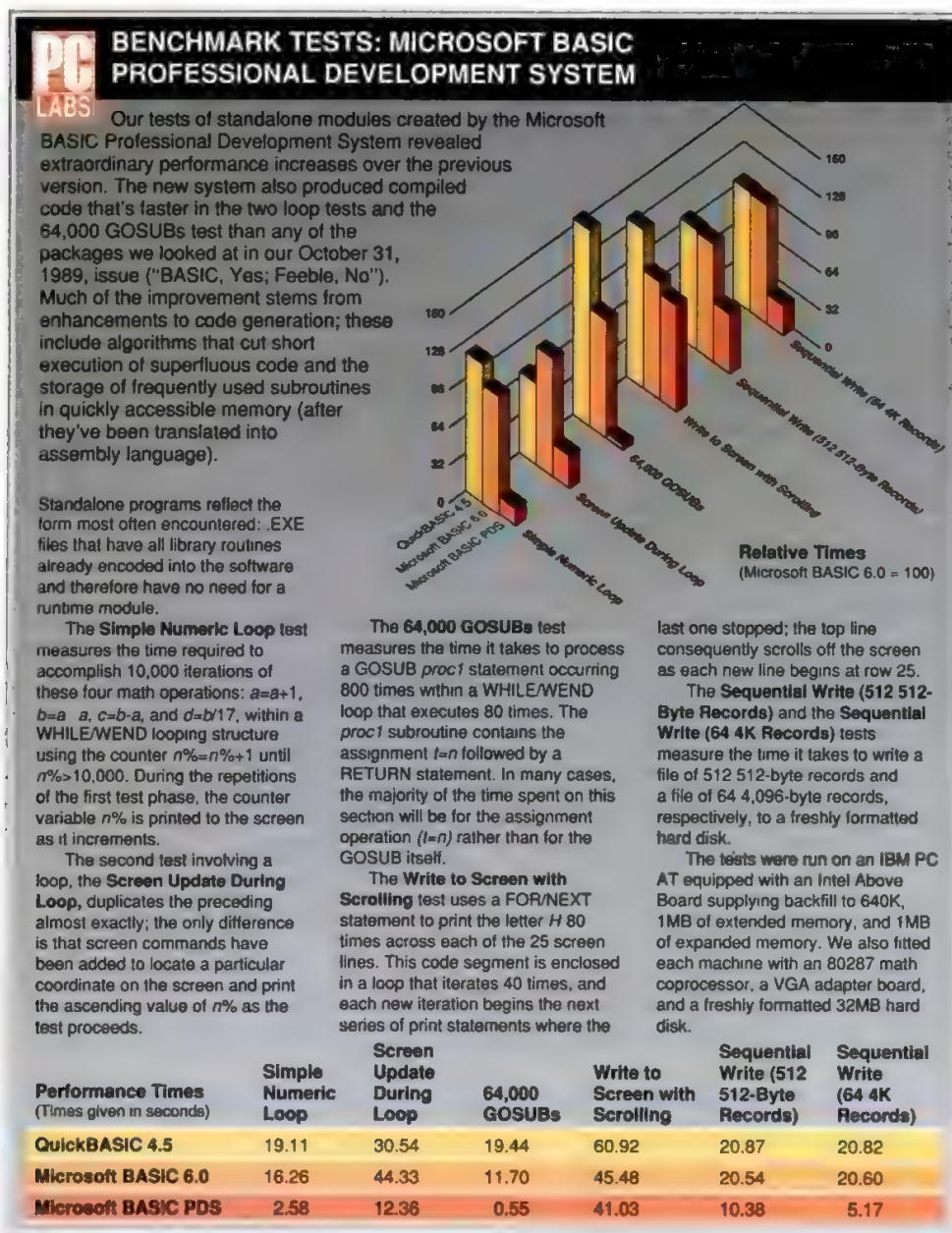
clude multiple tables and multiple indexes. All tables and indexes are stored within the ISAM database, as is the data dictionary information, so there is only one file per database. You can have a virtually unlimited number of tables and up to 28 indexes per table with ten columns per index. An ISAM database can grow as large as 128MB.

The ISAM engine itself can be loaded as a terminate-and-stay-resident program or linked to your program directly. Support for transactions with appropriate commit and rollback logic is included, but currently the ISAM is a single-user, DOS-only system. Although creation of OS/2 programs is possible with BASIC 7.0, ISAM cannot currently be used. Index maintenance is automatic and transparent, and a utility is provided to occasionally pack an ISAM database to remove or reorder dead space.

The new currency data type is intended to provide a faster, more memory-efficient alternative for fixed-point math. This is an 8-byte binary-scaled integer that provides 64-bit precision and accuracy to the ten-thousandths place (it provides 15 digits to the left of the decimal point and four digits to the right). Like BCD (binary coded decimal) math, it eliminates rounding errors. For most business applications that require a large range and fixed-point decimal accuracy, the currency data type will provide a better, faster alternative than floating-point math using BASIC's emulator.

Some new language features are included. For example, support for static arrays in records lets you create more-sophisticated data structures. Errors can be trapped and handled within subprograms. Improved support for DOS file control lets you gain access to file information without having to shell to DOS. For example, the DIR\$ function returns filenames within a given directory, and CURDIR\$ returns to the drive and path. Also, CHDRIVE lets you change to a specified drive.

You can create much larger programs using BASIC 7.0,



First Looks

thanks to new support for overlays and a compile-time switch that allows you to move string data into far memory.

Programming in the PDS environment is a pleasure due to an integrated development environment based on Microsoft QuickBASIC. It includes Microsoft's threaded p-code incremental compiler, which compiles your program as you work. The help system, Microsoft BASIC Advisor, is excellent, as well.

In extending the QuickBASIC environment for PDS, Microsoft has made some enhancements, such as an improved Undo command and a customizable utility menu that allows you to invoke DOS commands. And capacity improvements, including support for EMS, will let you work on larger programs within the environment.

Included with PDS are three object libraries and three toolboxes with sample code. The object libraries, derived from technology used in *Microsoft Excel*, provide routines for numeric formatting, date/time operations, and financial functions. The user interface, presentation graphics, and matrix-math source-code toolboxes are examples and are not of equivalent quality to many

FACT FILE

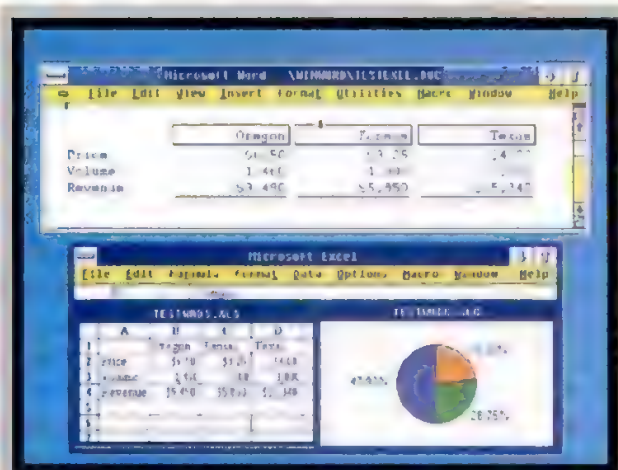
Microsoft BASIC Professional Development System
Microsoft Corp., 16011 NE 36th Way, P.O. Box 97017, Redmond, WA 98073-9717; (206) 882-8080.
List Price: \$495.
Requires: 640K RAM (EMS 4.0 is recommended), hard disk, DOS 3.0 or later or OS/2 1.1 or later
In Short: A superb environment for the creation of BASIC programs. Integrated support for ISAM and professional compilation features make this a good choice for business programming.

CIRCLE 441 ON READER SERVICE CARD

third-party libraries.

Perhaps the most-impressive improvements made to BASIC 7.0 are reflected in the numbers. Thanks to better code generation and improved runtime granularity, programs compiled in the BASIC Professional Development System are both smaller and much faster.

The Microsoft BASIC Professional Development System is a big step forward for BASIC. With integrated ISAM and a number of features designed to appeal to professional developers, it's a powerful tool for serious programmers. If you're a business software developer, this could become your tool of choice. ■



DDE (Dynamic Data Exchange) is a way of life for Microsoft's Windows applications. Here, spreadsheet data is hotlinked from Excel into Word for Windows. The Excel graph can be linked, too. Links from Word back to Excel can also be implemented. This feature augments the program's table-handling capabilities.

Word for Windows

CONTINUED FROM PAGE 33

much trouble getting used to *Word for Windows*. Most of the things you need to do—cutting, pasting, deleting, and moving text—will come easily and naturally enough, although if you're not used to *Windows* and its mouse-clicking, pulled-down menu ways, you will need to do a little bit of learning.

Word for Windows provides two optional graphics gizmos, called the Ribbon and the Ruler, that sit atop your screen and provide quick, easy access to character and paragraph formatting, and that make creating styles almost trivial. Just click on the designated buttons of the Ribbon to format text for bold or italic, change font or type size, add sub- or superscripts, underline text, or just about anything else.

Similarly, clicking on Ruler buttons lets you move paragraph indents and margins, tune up line spacing, set tabs, or even change intercolumn spacing in a multiple-column document. If you feel uncertain, just click on any open area of the Ribbon or Ruler and you'll be presented with the standard *Word for Windows* format dialog boxes, where every facet of the selection's format is presented and can be changed.

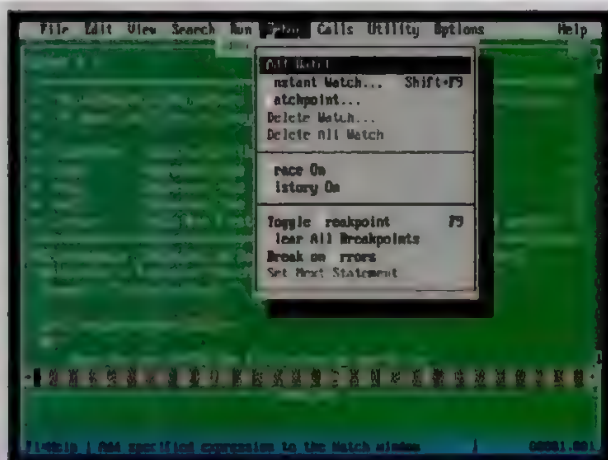
To create a style, just format

your paragraph and characters to look the way you want, and then click on the style button in the Ruler. When the style selection box drops down, type in a new style name and, just like that, you've defined a new style. If you're modifying an old style, just click on its name, confirm the change, and it's done. Similarly, to apply a style to text, click on the button, click on the style name you want, and that's that.

You can edit headers and footers in page view or in a separate panel that includes yet another graphics gizmo that makes it easy to insert date, time, and page number fields. You can also insert other fields, such as author name and document title, page count, and word count, anywhere in your document.

Word for Windows' tables are handy ways to organize sections of your document into rows and columns. You can use them for straight text tables or for numeric tables in which mathematical relationships can be defined. If this minispreadsheet capability isn't enough, you can either hotlink your document via DDE to a *Microsoft Excel* spreadsheet or warmlink it to *Lotus 1-2-3*. You can also insert any graphic saved in TIFF format, including tables, into any part of your document.

CONTINUES ON PAGE 36



Microsoft BASIC PDS's integrated development environment includes a fast incremental compiler, a built-in debugger, and the Microsoft BASIC Advisor.

First Looks

Word for Windows

CONTINUED FROM PAGE 35

Word for Windows offers formatting capabilities that are nearly as flexible as any you'll find in a desktop publishing package; the program is equally flexible in displaying the results. Views include everything from draft mode, which is ugly but fast, to page preview mode. You can edit text boundaries and graphics position in page preview mode, or you can go back to something in between, like page view mode, where you can edit everything on the WYSIWYG screen.

Electronic spellers and thesauri have been around for a while, and though they're all useful, none are perfect. *Word for Windows* is no exception here, but Microsoft's implementation of the Houghton Mifflin thesaurus is just about the best thing around. It provides synonyms with definitions, and it lets you explore each synonym's meaning for more words to think about.

The program's outline processor is so much fun to use that it could make believers out of writers who never use outlines. The outline processor comes with its own graphics gadget,

called the Outline Icon Bar, that appears when you shift into outline view. Headings are demoted or promoted, collapsed or expanded, moved, or even transformed into text as you click on the appropriate buttons. You can use the traditional outlining keys found in the DOS version of *Word* and other outline processors, but using the bar is so much faster that you'll soon forget which keystrokes do what.

Style sheets and glossaries, long familiar to DOS *Word* users, have been replaced by Document templates in *Word for Windows*. These include styles, glossary entries, predefined document text, and macros. Templates set the environment for each document, and they can even direct the author in how to create and format a new document.

You can use the macro capability to customize the program to meet your own needs or your company's standards. You can shift menu items from one menu to the next, delete them altogether, modify their text, or even change their meaning. You can also make Ctrl or Alt keystrokes whatever you want them to be.

Standard *Word for Windows* menu items are on an equal footing with user-created macros. Your macros can be run from menus or keystrokes or can take off automatically when a new document is created, when an old one is opened, or when *Word for Windows* is started. The macro language, which looks like a cross between C and BASIC, will seem quite familiar to *Microsoft Excel* users.

Templates can include glossary items, such as boilerplate text, that can be manually inserted, along with predefined *Word for Windows* fields, into text at any point. Macros can also insert text automatically or interactively. You can specify that boilerplate text be inserted into a document attached to a particular template whenever you open the document.

For managing large projects involving many authors or editors, *Word for Windows* includes such helpful tools as a revision-mark facility and a file

comparison command that uses the revision-mark protocols to let you know where changes have been made in the latest version of your document.

Editors or readers can insert comments into annotations rather than into normal text. The annotations are hidden unless you

et-sized. In addition, *Word for Windows* includes import and export filters that let your documents peacefully coexist with those created with these other products.

No aspect of *Word for Windows* is flawless. Like any first-generation product, the pro-



In *Word for Windows*' editable page view mode, you can modify text and graphics object boundaries, and you can move graphics or other objects with a mouse. You can also print results at any time without returning to the regular *Word for Windows* editing window. You can edit headers and footers in page view or in a separate panel.

choose to view them. You can lock your document so that only annotations can be inserted, deleted, or changed.

If these features don't satisfy your project management needs, the program also offers Goto and Macro buttons. The former will take you to a specified point in your document, and the latter will execute a macro or any *Word for Windows* command.

The *Word for Windows* help system is comprehensive, including hints for people familiar with the DOS version of the program and for those versed in *DisplayWrite 4*, *MultiMate*, Wang systems, *WordPerfect*, and *WordStar*. If that's not enough, the "Getting Right to Word" handbook delivered with the product is full of tips for users of those products. Other documentation includes a comprehensive, alphabetically organized reference manual, a document and template sampler, and a pocket guide that's very useful, albeit hardly pock-

gram has imperfections and shortcomings. The worst defects turn out to be inherent to *Windows*, however. The most important of these involves the program's handling of screen fonts. Although *Word for Windows*' programmers have improved on what's available directly from *Windows*, the fonts are far from perfect, resulting in a WYSINQWYG (what-you-see-is-not-quite-what-you-get) screen rather than a WYSIWYG one. It's a far cry from character-mode word processing, but a crying shame next to Macintosh-based word processing.

Will you be happy with *Word for Windows*? If all you ever do is write memos in 12-point Courier, probably not; the program will be overkill for what you do. But if you want to enter into a new generation of word processing and information management technology, take *Word for Windows* seriously. You might become the happiest word processing user on the block.

FACT FILE

Word for Windows

Microsoft Corp., 16011 NE 36th Way, P.O. Box 97017, Redmond, WA 98073-9717; (206) 882-8080.

List Price: \$495; upgrade from DOS *Microsoft Word*, \$150.

Requires: 640K RAM; EGA, VGA, or Hercules graphics adapter; *Microsoft Windows/286*, Version 2.11, or *Microsoft Windows/386*, Version 2.11; DOS 3.0 or later.

In Short: Microsoft's entry into the graphics word processing fray offers more features and tools than most word processors on the market and gives you easy access to them by making substantial use of the graphics environment.

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RAVE REVIEWS FOR GLYPHIX ■ "... unlike anything else on the market- except possibly PostScript... produces remarkably fine type at amazing speeds." PC Magazine, June 13, 1989 ■ "... offers a combination of features and performance that is unavailable elsewhere. Like PostScript, Glyphix generates fonts from outlines, on the fly, and sends them to the printer as they are needed. The Glyphix system's installation procedure is a snap: just put the appropriate floppy disk in drive a: and type INSTALL. You're asked a few questions about printer port and directories, and then everything happens automatically." Computer Buyers Guide and Handbook ■

AND USERS AGREE ■ "Your approach to font generation is the right one--better than Bitstream, MoreFonts, Trionum, you name it." Christopher Sarson, Blue Penguin Productions, Inc. ■ "I've now been using GLYPHIX 3.0 with WordPerfect 5.0 ... I couldn't be happier with the quality, ease of use, and, most of all, printed output of this product." Claude Carle, Beverly, Massachusetts. ■ "I am using WordPerfect 5.0 and was using Bitstream Fonts. I carefully removed my Bitstream to make room for Glyphix, thinking that if it did not work out, I could go back to the Bitstream. But I will not go back." Lorne Bowerman, R&L MicroServices Inc. ■ "As a WordPerfect certified instructor, I feel that all my students should know about your program and I make a point to mention it." Don Williams, Computer Learning Centers of America. ■

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TECHNICAL REQUIREMENTS IBM PC AT, XT, PS/2 or compatible with a minimum of 512Kb RAM, a hard disk, MS-DOS 3.0 or later, a LaserJet Plus, Series II or compatible printer with 512Kb of printer memory

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Zenith's First EISA PC: Strong on Disk Caching, Easy on Budgets

HANDS ON
by Gabe Vencione

And now comes EISA.

Compaq grabbed the glory for Extended Industry Specification Architecture when it took the wraps off its nearly ready SystemPro last November, but Zenith proved to be more aggressive about getting its 32-bit EISA PC out the door.

This month, the Z-386/33E is on the market, combining a 33-MHz 386 and a disk-caching controller through the wide bandwidth of an EISA bus.

The EISA spec may eventually prove to be a 486 vehicle, but Zenith opted to use a 386 in the interest of getting its system ready as soon as possible.

Zenith's use of a 386 in an EISA box mutes the bragging rights the company has earned for being so early. But with a list price of \$11,999 for a 5MB system with a 150MB hard disk, the Z-386/33E delivers the latest standards at a reasonable price. (Compaq's AT-bus Deskpro 386/33, with half the RAM and an 84MB hard disk, costs the same.)

The real story in the Z-386/33E is the 32-bit disk-caching controller. Two processors and 1MB of dedicated cache

RAM speed transfers with the Miniscribe 3080E disk.

An NEC V20 controls the cache, and a DTC processor is dedicated to communication with the disk. As a result, read requests can be filled from the cache at the same time more data is being sought on the disk.

When the controller powers up, it defaults to AT compatibility; with device drivers installed, however, it can access an extended register set that lets it address four hard disks and perform commands in parallel,

instead of the AT's default of two hard disks and serial command processing.

A bus master chip on the controller avoids the bottlenecks that occur when data transfers are waiting for CPU access by giving the disk transfers direct access to memory.

With simultaneous access to multiple drives, however, the possibility of another kind of bottleneck is raised. Only one disk can transfer data through the controller at a time; the others have to wait. To minimize

the delay, Zenith developed a position-sensing technique to give the disk with the shortest seek and head-positioning time first priority.

The device drivers for OS/2, Unix, and NetWare are not yet completed, so I wasn't able to get four disks running. With the single 150MB drive, the Z-386/33E showed dramatically better throughput on the PC Labs benchmark tests than similar PCs with similar disk drives.

Although Zenith was one of the early makers of "processor-on-a-board" PCs, the Z-386/33E has all processor functions on the system board, with no allowance for a 486 upgrade.

Zenith's Z-386/33E may not be the ultimate in EISA designs, but for a pioneering machine with strong disk-processing power, it's very aggressively priced.



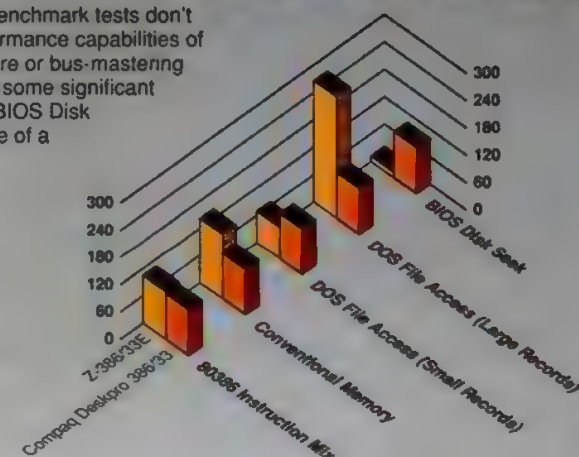
BENCHMARK TESTS: Z-386/33E

Although our standard benchmark tests don't really measure the performance capabilities of the Z-386/33E's EISA architecture or bus-mastering drive subsystem, they do reflect some significant hard disk speed increases: the BIOS Disk Seek numbers are close to those of a caching disk controller subsystem.

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching.



Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is

performed without software disk caching. Fast times are advantageous when large files are loaded.

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)	BIOS Disk Seek
Z-386/33E	1.74	0.36	35.98	10.32	1.92
Compaq Deskpro 386/33	1.66	0.25	52.27	3.89	16.33



FACT FILE

Z-386/33E

Zenith Data Systems, 1501 Feehanville, Mt. Prospect, IL 60056; (800) 553-0331.
List Price: With 4MB RAM, 150MB hard disk, 1.44MB 3.5-inch floppy disk drive, Microsoft Windows/386, and DOS 3.31+, \$11,999; with 320MB hard disk, \$13,799.

In Short: Arguably the first EISA PC to ship, this 33-MHz 386 machine is strong on network disk support and reasonably priced.

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Landmark 0.99	58.7	43.5	26.1	20.8	15.7
MIPS	7.7	6.2	3.8	3.2	2.09
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Cache Hit Rate	87%	87%	N/A	N/A	N/A

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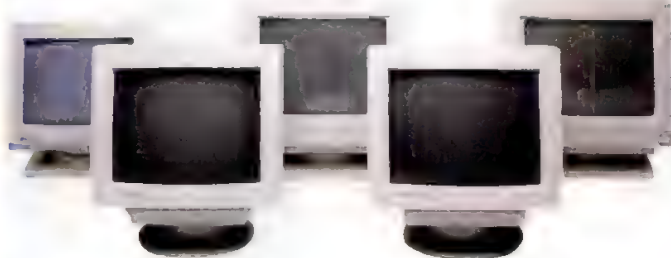
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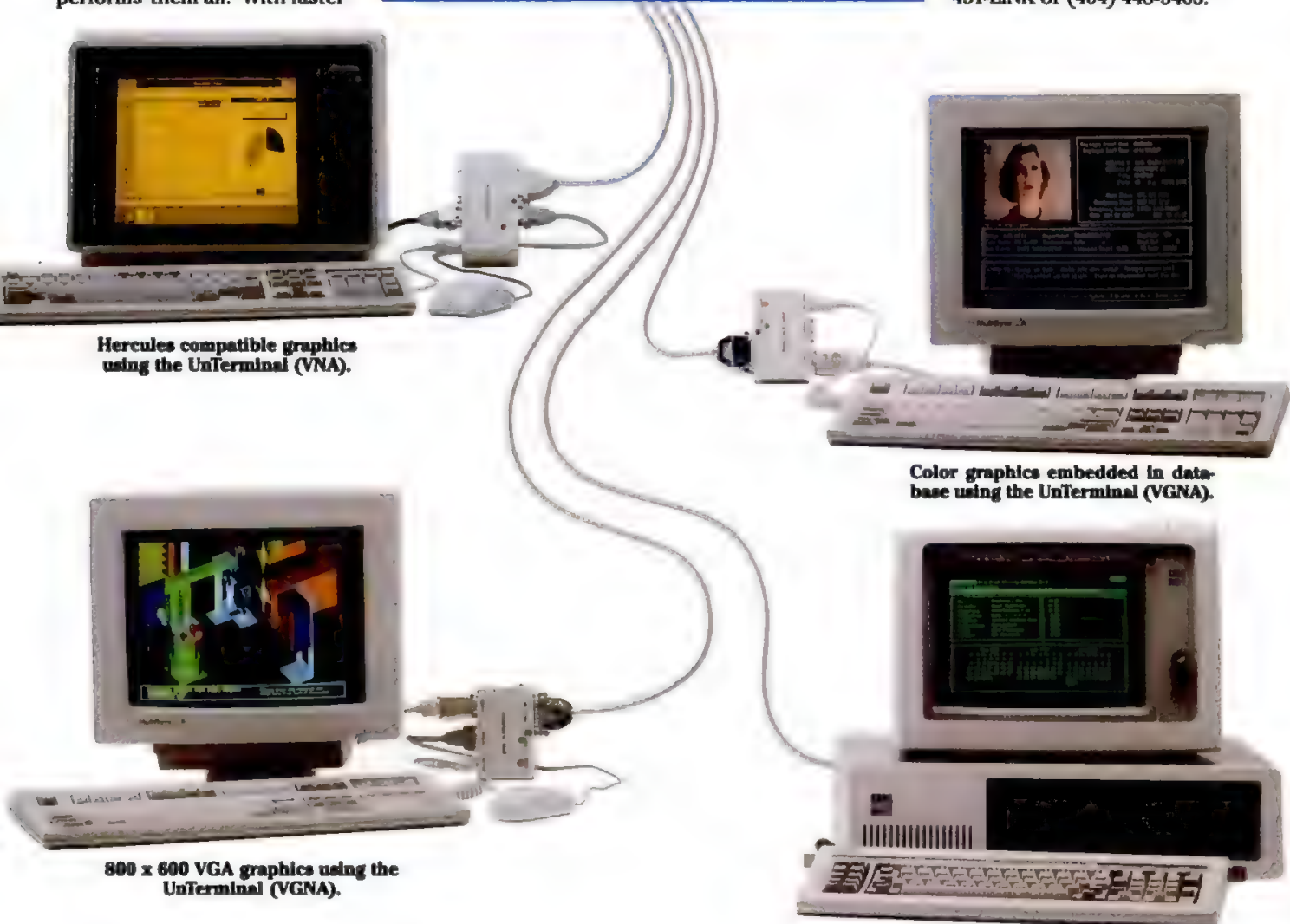
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First Looks

\$1,395 Okidata OkiLaser 400 Boasts 17 Internal Fonts, Two Paper Paths



The diminutive OkiLaser 400, from Okidata, is more proof that low-cost page printers are likely to become one of the most exciting product categories of the year.

With a list price of just \$1,395, the OkiLaser 400 competes with Hewlett-Packard's latest entry, the LaserJet Series IIP; its street price could easily be more than 10 percent lower than that of the \$1,495 IIP, which is already selling for under \$1,000. Like the IIP, the OkiLaser 400 offers 300-dot-per-inch resolution and packs a 4-page-per-minute print engine. It's compatible with the HP LaserJet Series II and accepts downloadable fonts in HP formats.

Both the LaserJet Series IIP and the OkiLaser 400 are compact and light compared with older page printer designs. The 5.25- by 17.7- by 23-inch (HWD) OkiLaser is a few inches lower, wider, and shorter than the IIP (with paper trays in place) and, at 24 pounds, just 2 pounds heavier. The printer comes with 512K memory (expandable to 2.5MB), serial and parallel ports, and a 16-character LCD panel with membrane switches. Accompanying documentation is well written, taking an ambitious—but not comprehensive—pass at a variety of

related topics; among these topics are desktop publishing design and the use of the printer with various popular application programs.

Unlike Canon-engine printers, which use all-in-one consumables, the OkiLaser 400 uses a separate cylindrical toner cartridge and drum assembly. Each \$33 toner cartridge is capable of printing 2,500 pages of text. The \$289 drum assembly should be replaced every 15,000 pages, or with every sixth toner change. The cost of consumables for 15,000 pages is about \$487, as opposed to about \$400 for the IIP.

The OkiLaser also differs from the IIP in the way it creates an image on the drum. The IIP uses a laser with a rotating mirror, while the OkiLaser 400 relies on a light-emitting diode (LED) array—a strip of tiny lights that flash on and off to expose the light-sensitive drum. The main advantage of this design over a laser printer is that there are fewer moving parts. On the other hand, if one of the 2,400 LEDs in the array failed, you would need to replace the entire strip, since print quality could suffer if the exposed array were to get dirty while being repaired. In fact, the manuals that accompany the OkiLaser recommend that you clean the strip every time you change a toner cartridge.

But the biggest differences

between the IIP and the OkiLaser are the fonts and the paper-handling capabilities. The OkiLaser comes with 17 internal fonts (including some useful proportional typesets, like a compressed 10-point Times Roman), as opposed to the IIP's seven internal fonts. However, the OkiLaser cannot automatically rotate these from portrait to landscape like the IIP. But you can set the OkiLaser to emulate a LaserJet with either a "B" or "F" font cartridge installed.

The OkiLaser 400's internal fonts have a much lighter appearance than HP fonts, and some users may not find the Times Roman typeface as visually appealing as versions used by some other printers. The OkiLaser 400 does not accept HP font cartridges, but it uses its own credit-card-style font cards, which list for \$195 each.

The printer has a 200-sheet paper tray, which is an improvement over the 50-sheet tray that comes with the LaserJet Series IIP, and it offers both straight-through and face-down paper paths. The face-up path ends at a little fold-out tray, which relies on some awkward arms that swing out to catch the paper. It's not an elegant design, but it's functional.

As for performance, the OkiLaser 400 holds its own. On the PC Labs text speed test, it managed a rating of 4.1 pages

FACT FILE

OkiLaser 400
Okidata, 532 Fellowship Rd., Mt. Laurel, NJ 08054; (800) OKI-DATA.
List Price: \$1,395; toner cartridge, \$33; imaging drum, \$289; font cards, \$195 each; optional paper trays, \$89 each.
Dimensions (HWD): 5.25 x 17.7 x 23 in.
Weight: 24 lbs.
Emulations: HP LaserJet Series II.
In Short: A 300-dpi, 4-page-per-minute page printer based on LED rather than laser technology. It's small, adequately fast, and has an attractive collection of extra features and benefits.

CIRCLE 443 ON READER SERVICE CARD

per minute, which is faster than its own rated speed and .2 ppm faster than the IIP. It was a bit slower than the IIP on our graphics speed test—averaging 70.6 seconds compared to the IIP's 53.3 speed. Print quality was similar on both, including deep, smooth areas of solid black, although the OkiLaser 400's print samples tended to be a little lighter and washed-out on gray areas. The OkiLaser 400 handled envelopes through its manual-feed feature without a hitch.

The only problem I observed was that the tabs on the paper-tray cover broke off too easily. But the cover still fit snugly, and the loss of the tabs did not affect the printer's operation.

With its attractive list price, the OkiLaser 400 is a good low-end choice. While it may not conquer HP's entry in this field, it offers some advantageous features that are missing from the Series IIP.

Once you've torn down all o laws in the country and you yourself face to face with tl Devil, what will you hide be

Courier **Bold** Underli

Line Printer Bold Underline Compre

Tms Roman 10 **Bold** Underl

OkiLaser 400

Text Speed

DEFAULT

0 1 2 3 4 5 6 7

4.1 ppm

Graphics Speed

POSTSCRIPT

0 10 20 30 40 50 60 70 80 90 100

70 sec.

WordPerfect 5.1 Adds Pull-Down Menus, Mouse Support, Tables, and Equation Editor

HANDS ON
by Edward Mendelson

Every new version of *WordPerfect* is designed to take away your excuses for using any other word processor. Version 5.1 of WordPerfect Corp.'s \$495 document factory undercuts excuses used by timid beginners and high-powered business and scientific users.

Beginners who were daunted by *WordPerfect*'s dense function-key interface now have optional pull-down menus. Business users who want to include tables in their documents can now construct complex layouts by moving the cursor and pressing a few menu keys. Scientific users can now create equations thanks to a flexible and intuitive editor. Every user can now use a mouse to block-define text, navigate through a file, or make menu choices. Every user also gets uniquely thorough, context-sensitive help.

Version 5.1's keyboard interface is almost identical to that

of 5.0, although some features are more logically presented and have added conveniences. The page size menu, for example, now offers only settings actually available at your printer, and it adds functions that let you create mailing labels effortlessly. The manual, once overly laconic, is still arranged alphabetically, rather than by topic, but now fills more than 1,000 densely packed pages.

With *WordPerfect* 5.1, you don't have to wonder whether you can print the characters you need. With any supported dot matrix or laser printer, *WordPerfect* now automatically prints a character as a graphical element if it isn't included in your fonts. Available character sets include the Greek, Hebrew, and Cyrillic alphabets, the Japanese syllabary, and a few hundred scientific and technical symbols and all the characters needed to print equations. *WordPerfect*'s versions of non-Roman alphabets look scrawny when compared with printer fonts, but they're better than

nothing at all. You can display only a limited number of characters on the editing screen, but the print preview screen displays the rest. Only *Nota Bene* boasts comparable foreign-language support in a full-featured word processor.

The new table editor is a triumph of design. When you build a table, you're prompted for the number of rows and columns, and you can then alter the dimensions by moving the borders with the arrow keys. You can also specify more-exact measurements from a menu. Any cell or group of cells can have its own border style, or no border at all. Tables can include proportionally spaced type and can be used for easy formatting of multiple-column text. However, because rows in tables can't straddle a page break, you'll still need *WordPerfect*'s less well-designed text column feature for most columnar text longer than a single page.

Tables can function as simple spreadsheets that perform arithmetic operations on the contents of cells. You can also import spreadsheets directly into a *WordPerfect* file from *Microsoft Excel*, *Lotus 1-2-3* (through Version 2.2), and *PlanPerfect* and from any spreadsheet that can save files in .WK1 format. The imported spreadsheet can be updated automatically whenever you open the *WordPerfect* file.

WordPerfect still isn't perfect. Many cursor movements

FACT FILE



WordPerfect, Version 5.1
WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; (801) 225-5000.
List Price: \$495.
Requires: 384K free RAM, two 720K or larger floppy disk drives or a hard disk, DOS 2.0 or later.
In Short: *WordPerfect*'s new table and equation editors, menus, and mouse support make it the most flexible and powerful of word processors.

CIRCLE 431 ON READER SERVICE CARD

still require too many keystrokes—although block moves and copies finally require a minimum number. When you insert words into a line of existing text, the end of the line won't wrap to the next until you move the cursor down. As a result, when you move the cursor down to a word you want to edit on the line below, you're sure to miss it, because the delayed word wrap causes the word to change position as you move toward it. No other major word processor has this annoyance.

For editing text, *Nota Bene* and, to a lesser extent, *Microsoft Word* are generally more convenient to work with than *WordPerfect*. And *Word* has full outline functions where *WordPerfect* has only outline-style paragraph numbering and indentation.

Minor bugs lurking in the first release of Version 5.1 caused a few conflicts with some expanded-memory simulator software and also made the wrong fonts appear in print preview with the Hercules and some other screen drivers. We expect that both of these problems should be fixed by the time you read this, making *WordPerfect* 5.1 an extraordinarily solid and reliable program, with a richer set of features than any of its rivals. ■



The equation editor in *WordPerfect*, Version 5.1, uses a simple but powerful and flexible syntax for creating equations. You have to press a pair of keys to display the graphic after entering commands.



The table editor in *WordPerfect*, Version 5.1, lets you create complex tables using a menu. To resize all or part of the table, you block-define the part you want to change and move the cursor.

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First Looks

Drafix Windows CAD Uses Graphical Environment, Costs a Fraction of AutoCAD

HANDSON
by Jeff Fries

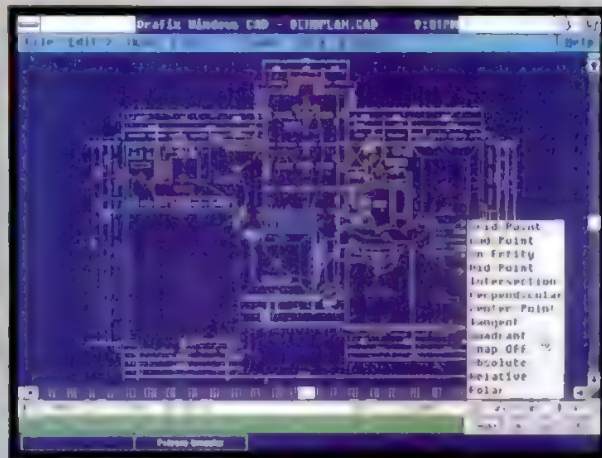
The new *Microsoft Windows* version of Foresight Resources Corp.'s popular *Drafix* may only work in 2-D, but *Drafix Windows CAD* packs many of the features of such top-notch programs as *AutoCAD* and *Cadkey* at a fraction of the cost. The \$695 program is the first product of its kind to run under *Windows*, which brings the power of vector graphics to PC-based CAD.

Foresight Resources Corp.'s goal is to make *Drafix Windows CAD* to the CAD world what *Microsoft Excel* is to the spreadsheet world. With *Drafix*, you can make sleek architectural and engineering drawings and have access to all the benefits of the *Windows* graphical user interface and its hardy support for input and output devices. When you want to pan across a drawing, for example, you can scroll horizontally or vertically using scroll bars positioned at the borders of the windows. You invoke commands from pull-down menus at the top of the screen.

Should you want to work in more than one view at a time, *Drafix* lets you split the screen into as many as four viewports. Unlike many CAD programs, which support multiple views but only in predefined configurations, *Drafix*'s viewports are infinitely scalable via a pair of sliders located adjacent to the scroll bars.

One of the most appealing features of *Drafix*'s user interface is the set of control buttons along the bottom of the screen. Changing often-accessed drawing parameters—such as pen color, line type, layer, and snap mode—activating a fast zoom, or undoing the last command you executed is as easy as clicking a button.

Depending on how you've



If you prefer speed to elegance, *Drafix Windows CAD* lets you select from pop-up menus rather than dialog boxes.



Drafix Windows CAD can display four views of the same drawing. Each viewport can be manipulated independently.

set it up, *Drafix* either pops up a dialog box that lists all your possible choices for a specific operation or displays a menu with which you select items by issuing a single click. *Drafix* never leaves you guessing or trying in vain to remember filenames; everything, from selecting hatch patterns to the sizing of windows, is a highly visual process.

As a 2-D CAD system, *Drafix Windows CAD* offers most of the features that you've come to expect from high-end drawing

products. Support for drawing entities ranges from simple lines to splines and Bezier curves. Dimensions are associative, and text handling is robust enough to include a windowed full-screen text editor, which makes entering and editing multiline text a real snap. When you get stuck, an on-line help facility is only a mouse click away. Help text appears in a window that you can move and resize as needed.

The powerful *Drafix Graph-*

ics Language, a C-like programming language tailored for the *Drafix* drawing environment, lets you create your own macros, menus, and commands. A handy project information feature lets you store project-related information such as project title, company name, and drawing number along with each drawing you file. In addition, the program includes a symbols library with more than 400 predefined objects for architects and engineers.

No program is flawless, especially in its first release. *Drafix Windows CAD* is no exception. The help system is slightly buggy, and enclosed regions on the drawing can't be cross-hatched after the fact. They can be created as filled polygons, but polygons can't include non-linear drawing entities such as arcs and fillets. In the current version, you can't place a diameter dimension outside a circle, nor can you create custom leader lines without piecing them together from other entities. In addition, the program is annoyingly slow at times, even on a 386—not so much a result of the way it was written but of the environment it was built to run under.

But most *Windows* users believe that speed is a small price to pay for the myriad other benefits the environment has to offer. If you're in the market for a 2-D CAD package with a lot of bang for the buck, give *Drafix Windows CAD* a look.



FACT FILE

Drafix Windows CAD, Version 1.00

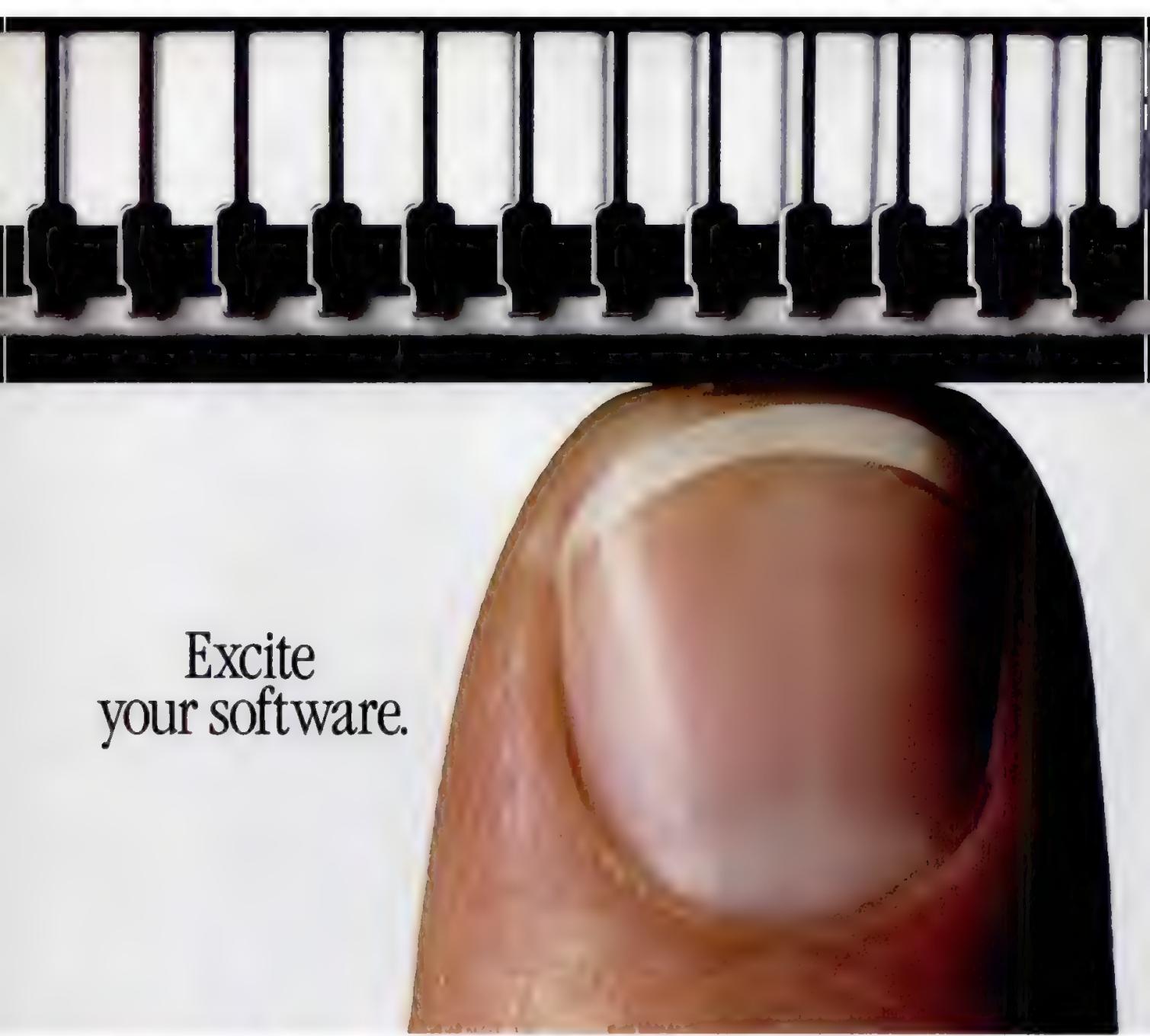
Foresight Resources Corp.,
10725 Ambassador Dr.,
Kansas City, MO 64153; (800)
231-8574, (816) 891-1040.

List Price: \$695.

Requires: 1MB RAM, hard disk, mouse or digitizer, *Microsoft Windows* 2.1 or later; Intel 80x87 math coprocessor recommended.

In Short: The first 2-D CADD package that runs under *Windows*. Packs the punch of many programs costing much more.

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CIRCLE 142 ON READER SERVICE CARD

First Looks

Move'em Extends Advanced Memory Management to 8088, 80286 Machines

HANDS ON

Memory remapping is one of the most useful capabilities of the 80386 processor, as it allows DOS users to load memory-consuming TSRs and device drivers into unused address spaces between 640K and 1MB, and (on monochrome and CGA systems) to use the region reserved for high-resolution graphics as conventional memory. Now Qualitas has extended some of the same capabilities to users of 8088- and 80286-based machines.

Move'em (\$89) lets you use some of the memory on your LIM 4.0 expanded memory card as addressable high RAM. On 286 clones based on Chips and Technologies' NEAT and LEAP chip sets, it can take advantage of the EMS memory mapping built into those systems to use motherboard memory as high RAM. It can even give you 64K of high RAM on older LIM 3.2-compatible EMS boards, though you have to give up your expanded memory in exchange.

Move'em works by using extra EMS pages that aren't needed for the EMS page frame. How much extra memory you get, therefore, depends on how flexible your EMS driver is in mapping these extra pages in the high address region.

Getting your drivers and TSRs loaded up high is a multi-step process for which you'll need a solid acquaintance with a text editor. After a short installation procedure, you set up the *Move'em* loaders for your device drivers and TSRs using the GETSIZE parameter. When you reboot, *Move'em* assesses the maximum RAM requirements of each program and determines the best loading order, which you can see with the program's Summary function. You

then go back and re-edit **CONFIG.SYS** and **AUTOEXEC.BAT**, replacing **GETSIZE** with the appropriate **SIZE** parameter. Though long, this procedure is well documented and saves much trial and error on more-complex setups.

Move'em's compatibility results were generally good, though not perfect. It worked just fine with ANSI.SYS and VDISK.SYS, with the PC-Kwik Power Pak utilities, with Ultravision, and with Novell's NET3 and IPX network drivers. But my Dell 286 system locked up tight trying to high-load my Microsoft-compatible serial mouse driver and Ultravision's

ANSI driver. And a glitch in the version I tested prevented *Move'em* from working with *Microsoft Windows*, though the company says it is working on this problem.

Move'em can be an excellent alternative to more-expensive, hardware-based solutions to RAM cram, such as the All Chargecard. But without hardware remapping, even more than usual, the rule is try before you buy in quantity. You may also want to wait to compare a similar program due soon from Quarterdeck Office Systems to see if that company can do any better. ■

List Price: Move'am, Version 1.0, \$89. **Requires:** LIM 4.0 expanded memory card with 256K RAM or PC with LEAP, NEAT, or AT/386 chip set and 1MB RAM; 256K conventional RAM; DOS 3.0 or later. Qualitas, 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; (301) 907-6700.

CIRCLE 445 ON READER SERVICE CARD

Move'em lets you load resident programs into high memory using the mapping capabilities of EMS 4.0 boards.

PubTech Batchworks Brings Batch Language, Macro Programming to Windows

WANDERLUST
by Betty Starnes

As users begin to think of *Microsoft Windows* as an environment rather than as a shell for *Microsoft Excel* or *PageMaker*, the limitations of the tools in MS-DOS Executive become more apparent. The first wave of helpful tools were the menuing shells, like *Wilson WindowWare's Command Post* and *Publishing Technologies' PubTech File Organizer*. Now,

Morrie Wilson, the author of *Command Post*, has teamed up with the developers of Publishing Technologies to produce *PubTech Batchworks*, a batch language and macro program that is useful for running multiple *Windows* applications.

PubTech Batchworks is easy to use, but it's far from elegant. It has the same limited flow control as DOS's batch language (if . . . then, goto, and call). It won't afford you access to modern structured programming

techniques (such as while loops and case statements), but since it supports arithmetic on numeric variables, you can easily code your own loops. Although *Pub-Tech Batchworks* has no arrays, it supports replaceable references even in variable names, so you can make your own sets of variables that act just like arrays.

Batchworks handles a large set of functions that you'd want to perform in *Windows*, but it doesn't support Dynamic Data Exchange (DDE). The program lets you run, maximize, iconize, move, and stack open windows, and it will do string and file manipulation. If you're ambitious, you can put up dialog boxes with file-list boxes, radio buttons, check boxes, and push buttons, but the procedure is unnecessarily awkward, requiring that you use a separate file for the dialog box.

Keyboard interaction is central to *Batchworks*. You can send keystrokes to applications and record sendkey strings to a file for later editing if you run *Batchworks*' separate macro program. This macro program lets you run batch files from macros that can be invoked with hotkeys or placed in the control menu of applications. Here again, the procedure is awkward: you must assign hotkeys via a text file, not interactively.

How does *PubTech Batchworks* stack up against its closest competitor, SoftBridge's *Bridge*? The latter program supports arrays, handles DDE, offers more support for DOS applications, and has a wonderful dialog editor—all of which are missing from *Batchworks*. But at \$125 and \$695 for the runtime and toolkit versions, respectively, *Bridge* is considerably more expensive than *Batchworks*. If you can live without those features, *Batchworks* should suffice for most of your needs. ■

List Price: PubTech
Batchworks, Version 1.0, \$99.95
(\$79.95 until March 1).

Requires: 640K RAM, *Microsoft Windows 2.03* or later, *DOS 3.0* or later. Publishing Technologies Inc., 7719 Wood Hollow Dr., #260, Austin, TX 78731; (800) 782-8324.

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Corel Draw! 1.01 (Corel Systems Corp.)	82	2.4/1.0	89	86	84	83	82	83	78	82	79	83	73	81
Arts & Letters Graphics Editor 1.02 (Computer Support Corp.)	80	3.0/1.0	87	80	84	79	78	79	76	82	74	78	90	76
Micrografx Designer 2.0 (Micrografx Inc.)	78	6.3/1.0	84	80	80	77	73	78	78	81	74	74	78	77
Kinetic Art 1.20G (Kinetic Presentations Inc.)	76	11.6/2.0	92	83	80	67	76	64	58	76	87	83	63	78
Artline 1.0 (Digital Research Inc.)	72	3.7/1.0	87	77	81	70	71	69	61	78	66	74	57	67
Adobe Illustrator 88 1.8 (Adobe Systems Inc.)	71	5.6/2.0	83	68	78	73	61	76	70	74	70	62	63	67

REPORT CARD

PC Illustration Software (InfoWorld weighting)	Adobe Illustrator Windows Version 1.0	Arts & Letters Graphic Editor 1.02	Corel Draw 1.01	GEM Artline 1.0	Micrografx Designer 2.0
List price	\$695	\$695	\$495*	\$495	\$695
Performance (125)	Poor	Satisfactory	Very Good	Very Good	Very Good
Speed (125)	Good	Good	Very Good	Good	Excellent
Input/output (200)	Good	Good	Very Good	Satisfactory	Very Good
Drawing/editing (100)	Excellent	Good	Excellent	Satisfactory	Very Good
Documentation (100)	Very Good	Satisfactory	Good	Good	Good
Ease of learning (100)	Satisfactory	Satisfactory	Very Good	Satisfactory	Good
Ease of use (75)	Good	Satisfactory	Good	Poor	Poor
Error handling	Satisfactory	Satisfactory	Very Good	Good	Good
Support (50)	Good	Very Good	Excellent	Good	Very Good
Support policies (50)	Poor	Satisfactory	8.8	8.8	7.2
Technical support (75)	8.8	8.7			
Value					
Final scores					

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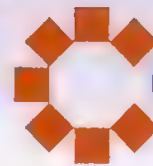
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ABOUT FASTBACK PLUS

MAN LOSES HAIR WAITING FOR DOS

Anytown, USA—The unidentified victim was apparently among the millions of people who still think that DOS Backup and Copy commands are a safe and convenient way to back up their valuable hard disk data. It is not known whether the shocking loss was a result of natural aging while DOS made the backup, or whether the victim pulled his hair out in frustration after discovering that a minor disk error had rendered his entire backup set useless.

According to reliable sources, the tragedy could have been averted if the man had been using FASTBACK PLUS, the world's fastest and most reliable backup software. A special commission has been appointed to study ways in which the public can be made aware that FASTBACK PLUS' Advanced Error Correction, easy-to-use menu, flexible file and directory selection, automated backup options and other features allow even beginners to make fast, foolproof backups.

Public knowledge of these facts could ease the wide-spread stress and trauma that result from using DOS commands to back up hard disk data.

This product is in no way associated with or has origination in Fisher Scientific or Allied Corporation



ELVIS' SPIRIT TRAPPED IN MICROCHIP

Spreads invente by pre

d bride
sits on
rch steps
or 2 years

PC industry
controlled
by UFO aliens



FIFTH GENERATION SYSTEMS *The Creators of FastBack*

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First Looks

Label Software for Laser Printers: Two New Programs Offer a Choice Between Simplicity and Stunning Results



The laser printer revolution is not over yet, and many people find that an old-fashioned typewriter is handy for such tasks as addressing envelopes and creating labels. Two new programs help seal the fate of the typewriter, however, as they address the problem of generating labels with a laser printer.

Avery's *LabelPro* and Mind Path Technologies' *Laser-Ready Labels* take two different routes toward solving the label-printing problem, and each has its own strengths. Both are easy to use and have simple menus and on-line help. That's where the similarities end.

Laser-Ready Labels (\$69.95) is the simpler of the two. Its interface is strictly low-resolution CGA, and it knows far fewer fonts and formats than *LabelPro*. All the same, it is better suited for many applications than *LabelPro* because of its simple approach.

The program works with the HP LaserJet Series II or LaserJet Plus, as well as supporting the HP DeskJet and many dot matrix printers. You choose to work with mailing, shipping, or general label formats. For each set of labels, you pick a label sheet (corresponding to the 3M label stock number) and then choose from different font options, including LR-Helv, LR-Times, and LR-Elite. Your only control over layout is deciding to center or left-align some lines.

Within these limits, you design each label individually. You make as many pages of labels as needed, and you can display them one page at a time. Since the screen is CGA, you see only the first line of a label. When you select a label to edit, you get a data-entry screen showing all the lines. The pro-

gram knows about proportional-font character widths and will not let you type beyond the limits of a line.

You can create one label (or set of labels) and duplicate it as many times as needed. For example, if you have a few dozen related folders that you need to label, you can create a partial label first, make as many duplicates as you want, then edit each to add specific information.

You can also import data, but it must be in a field-per-line format. A README file explains how to create this format using a variety of popular programs.

Avery's *LabelPro* (\$99.95) has more features and is more flexible than *Laser-Ready Labels*, but the biggest difference between the two is in graphics support: *LabelPro* has gorgeous VGA menus and can incorporate .PCX images into labels. It comes with sample clip art and has some predefined labels that are ready to print.

Once you have chosen a format based on the type of label to be used—Avery offers many more formats than 3M, including file-folder, full-sheet, and circular labels—you select from a batch of layouts that offer dif-

ferent combinations of graphical and text areas, plus fixed rules and borders.

You then create the labels or import data. Unlike *Laser-Ready Labels*, the program does not offer an easy way to duplicate and edit labels that differ only slightly. *LabelPro* can read data directly from *dBASE*, *WordPerfect* mail-merge, and comma-delimited ASCII files, as well as from its own built-in list manager.

LabelPro has other nice touches. For example, a preview mode—complete with zoom in and out—lets you see what the finished product will look like. You select the typeface, size, and attributes for each line, so you get a high degree of typographic control. The program does not prevent you from creating lines that are too long, but a preview mode and a checking procedure should help you avoid problems. *LabelPro* even prints an alignment test page to help ensure that your labels will be centered properly.

Both products have their place, depending on the job at hand. For producing simple pages of labels quickly, or for repetitive labels that vary slight-



FACT FILE

Laser-Ready Labels

Mind Path Technologies,
12700 Park Central Dr., #1801,
Dallas, TX 75251; (214) 233-
0205.

List Price: \$69.95.

Requires: 512K RAM, hard
disk or two floppy disk drives,
DOS 2.1 or later

In Short: An easy-to-use
package that's best for creating
repetitive labels that vary
slightly from one to the next.

CIRCLE 447 ON READER SERVICE CARD



FACT FILE

LabelPro

Avery, Commercial Products
Division, 818 Oak Park Rd.,
Covina, CA 91724-3624; (800)
541-5507.

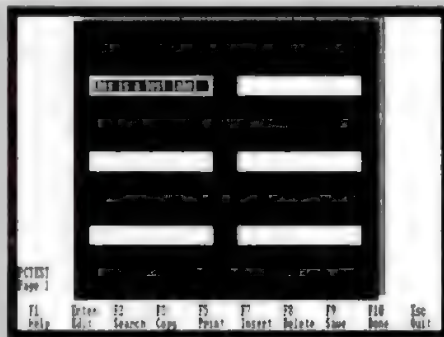
List Price: \$99.95.

Requires: 512K RAM, hard
disk and one floppy disk drive,
DOS 2.1 or later.

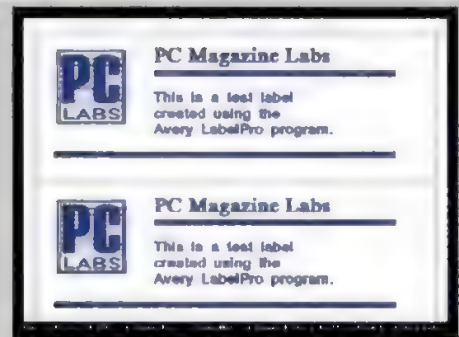
In Short: A more sophisticated
label generator that can
incorporate .PCX graphics into
labels.

CIRCLE 448 ON READER SERVICE CARD

ly from one to the next, *Laser-Ready Labels* is the better choice. If you are willing to take a bit more responsibility for the success of the final product, *LabelPro* is the one to use: its results can be outstanding, especially when you add a graphic to your file-folder or address labels. That's something no Selectric could ever do. ■



Laser-Ready Labels displays only the first line of a label, as demonstrated in this full-screen view of a page of general-purpose labels designed for 6-up labels.



LabelPro's graphic page preview with zoom makes it easy to see what your labels will look like before they are printed. These sample disk labels include a .PCX image of the PC Labs logo.

Northgate Slims Down!



Slimmer. Trimmer. The world's smallest 386, standing not even as tall as America's favorite diet cola. Obviously Northgate has lost a few pounds.

At least in the 386/20 pictured above. But it hasn't lost anything else. How do we pack a 20 MHz real 386 system with a 40 MB hard drive into this space saving, smallest 386 ever introduced?

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NORTHGATE COMPUTER SYSTEMS, INC.
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Plymouth, Minnesota 55441-41000
1-800 548 1993

New & Improved

News of Announced Products and Upgrades

LaserPort PS 600 Ups LaserJet Resolution

NEW

LaserJet owners looking for a little more in the way of resolution may want to add the LaserPort PS 600 to their printer. This controller, from DP-Tek, brings the world of 600 by 600 dots per inch to the LaserJet Series II, producing sharper edges, straighter lines, better halftones, and cleaner fonts, according to the company.

Packaged with the unit is *UltraScript PC Plus*, from QMS. A PostScript-compatible interpreter, *UltraScript* provides 47 scalable typefaces, including the base 35 fonts used in Adobe PostScript.

Software packages that operate with the PS 600/*UltraScript* combination include *PageMaker*, *Ventura Publisher*, *Microsoft Word*, *Microsoft Windows*, *WordPerfect*, *AutoCAD*, and *AutoShade*.

List Price: LaserPort PS 600 with *UltraScript PC Plus*, \$1,195. **Requires:** IBM PC AT, PS/2, or compatible; 5.5MB extended memory. DP-Tek Inc., 3031 W. Pawnee, Wichita, KS 67213; (316) 945-8600.

CIRCLE 435 ON READER SERVICE CARD

Compression Boards Boost Tape Drive Performance

NEW

Two new data-compression boards from Colorado Memory Systems can significantly increase the capacity and backup speed of minicartridge and standard-cartridge tape drives, according to the company.

The TC-15 Turbo-Compression board, which provides internal and external data connectors, is compatible with QIC-40 and QIC-80 minicartridge tape drives and plugs into a standard AT slot. According to the company, when used with long tapes, the board can increase the capacity of QIC-40

The TC-02 can up the capacity of QIC-150 drives to 500MB.



drives to 120MB and QIC-80 units to 250MB.

The TC-02 Turbo-Compression board is for use with QIC-150 standard-cartridge tape drives. Colorado Memory Systems claims

that TC-02 users can expand their drive's capacity to 500MB. Both boards must be integrated into backup software to function properly. They can be purchased by OEMs and by owners of the company's 120MB JumboPlus and 500MB QFA-500 tape drives.

List Price: TC-15 and TC-02 Turbo-Compression boards, \$399 each. **Requires:** QIC-40 or QIC-80 tape drive (for the TC-15), QIC-150 tape drive (for the TC-02). Colorado Memory Systems Inc., 800 S. Taft Ave., Loveland, CO 80537; (303) 669-8000.

CIRCLE 436 ON READER SERVICE CARD

CONTINUES ON PAGE 54

HOT PROSPECT

LOTUS NOTES SPREADS THE WORD ON LARGE LANs

More and more, work done on the PC is not accomplished by any one individual, but by groups. Accordingly, new "groupware" packages have been designed to facilitate this process, helping people on connected PCs work together.

Lotus Notes, from Lotus Development Corp., is one such package. It allows a group of users to assemble, organize, and distribute textual, numeric, and graphical information over a local area network. *Notes* is entirely menu- and icon-driven, and each node can access the program through either OS/2 and Presentation Manager or DOS and *Microsoft Windows*. The *Notes* server runs under OS/2 with Novell, 3Com, or IBM network operating systems.

Basically, the package works with information on three levels: dissemination, where information is "posted" for those who seek it; routing, where specific information is sent (much like electronic mail); and collaboration, where ongoing, "many-to-many" dialogues with constantly changing participants can be set up. Collaboration is the key feature of the product.

Data can be created through the WYSIWYG correspondence editor or imported from another package. The program supports file import from and export to *Lotus 1-2-3*, *Lotus Graphwriter*, *Lotus Manuscript*, *Symphony*, *Freelance Plus*, and *Agenda*, as well as *WordPerfect*, *Microsoft Word*, *MultiMate*, *WordStar*, and *DisplayWrite*. Information can also be imported from scanners, clipboards, and structured database files.

Notes-created documents can be displayed in "views," which select, sort, and categorize them by pertinent criteria. Through a "replication" feature, copies of *Notes* databases can be stored on multiple servers and updated automatically.

List Price: *Lotus Notes* is sold under a volume-purchase agreement; initial orders for an organization are bundled with on-site installation, training and application design, ten sets of documentation, six months of maintenance, including all updates, telephone support, and a license to install up to 200 machines in any combination of servers or workstations in any location. The price for this initial purchase is \$62,500. Additional nodes are \$295 each.

Requires: Node: IBM PC AT, PS/2, or compatible; 4MB RAM (5MB recommended) under OS/2; 640K RAM (1MB recommended) under DOS; hard disk. Server: IBM PC AT, PS/2, or compatible; 5MB RAM; OS/2 Standard or Extended Edition 1.1 or later. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; (617) 577-8500.

CIRCLE 434 ON READER SERVICE CARD

New & Improved

CONTINUED FROM PAGE 53

Personal Writer Combines Tablet, Keyboard

NEW

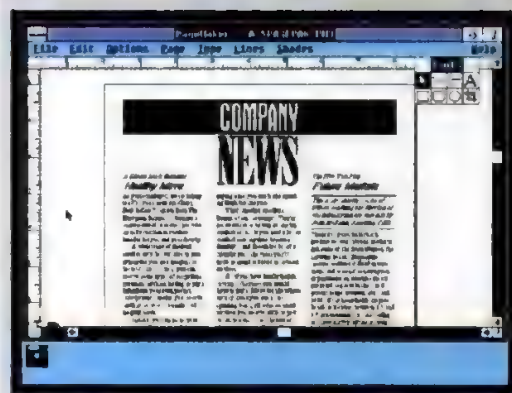
At first glance, the PW10SL, from **Personal Writer**, looks like a rather ordinary graphics tablet. Working with the 12- by 12-inch unit (larger models are also available), graphic artists and page-layout designers can trace, draw, and sketch images, as well as label illustrations, automate repetitive tasks, and rearrange text and graphics.

A 2.5-inches-wide strip to the left of the drawing area groups an assortment of point-and-shoot commands (you point with the pen). These commands include user-programmable macros and mapping and scaling options. Images can be mapped from paper to any window on the computer screen and scaled from 25 to 400 percent. A miniature keyboard is also provided here, although the PC's keyboard and mouse remain active.

To the right of this "command zone," an 8.5- by 11-inch area is used for drawing, tracing, and sketching. All images appear on the screen exactly as they were created on paper, according to the company. Complex keyboard or mouse operations can be programmed into the PW10SL as user-created macros, simplifying repetitive tasks.

List Price: PW10SL (12 by 12 inches), \$799; larger versions are also available (a 12- by 18-inch model retails for \$1,299). **Personal Writer Inc.**, 1900 Avenue of the Stars, #2870, Los Angeles, CA 90067; (213) 556-1001.

CIRCLE 438 ON READER SERVICE CARD



PagePak templates can be used with PageMaker and other DTP packages.

PagePak Offers Ready-to-Use Page Designs

NEW

More than just another "fill-in-the-blank" software package, **PagePak**, from **Marketing Graphics**, provides users with 50 differ-

ent, fully formatted page-layout designs for documents such as newsletters and charts. Each "template" incorporates artwork, borders, and headline fonts.

PagePak can be used with any word processing, desktop publishing, and presentation graphics package that supports .CGM or .PCX files. While users need only add text to the ready-to-go pages, clip-art images can be added, as well. For users of **WordPerfect**, Versions 5.0 and 5.1, the package also includes macros that automatically size and position the **PagePak** artwork and that move the cursor directly to the spot where text should be added.

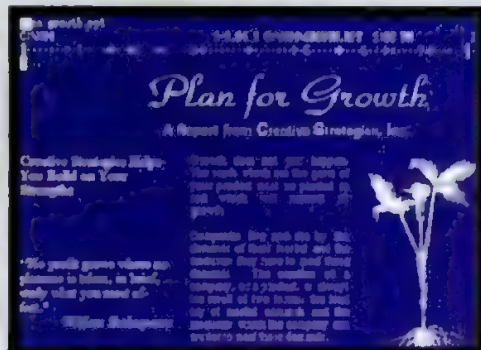
The 50 page designs include templates for charts, graphs, letters, labels, maps, diagrams, brochures, books, manuals, newsletters, and magazines.

List Price: **PagePak**, \$145. **Requires:** Any graphics or word processing application that accepts .CGM or .PCX file formats; RAM, disk, DOS, and printer requirements depend on application used. **Marketing Graphics Inc.**, 4401 Dominion Blvd., #210, Glen Allen, VA 23060; (804) 747-6991.

CIRCLE 437 ON READER SERVICE CARD

IMPROVED

XyWrite IV—Featuring editable WYSIWYG text, an expanded graphics-importing capability, and a new pull-down-menu interface, **XyWrite IV** represents a significant enhancement of Xyquest's popular word processing package. In its new WYSIWYG mode, **XyWrite IV** will allow users to view and edit the exact page layout of their document, including fonts and graphics. New font-definition and type-size commands have also been added. Furthermore, the package's expanded graphics-inclusion feature is now capable of importing scanned images, user-created graphics, and clip-art illustrations. Once imported into a document, these images can be viewed and manipulated through the program's WYSIWYG mode. While **XyWrite IV** will initially support PCL, TIFF, and .PCX images only, the company says that support for other formats will be added. Users will also be able to toggle between the package's standard command-line interface and the new pull-down-menu structure. **XyWrite IV** is expected to ship in the first quarter of the year at a retail price of \$495. Current **XyWrite** owners should contact the company for upgrade details. **Xyquest Inc.**, Billerica, Mass.; (508) 671-0888.



XyWrite IV's WYSIWYG display gives users an editable page preview.

Turbo Basic, Version 2.0 (PowerBASIC)—Now that Borland International has turned over the development rights for **Turbo Basic** to the compiler's original developer, Robert Zale, a

CONTINUES ON PAGE 56

NCL Hand Scanner Merges Color, Low-Cost Scanning

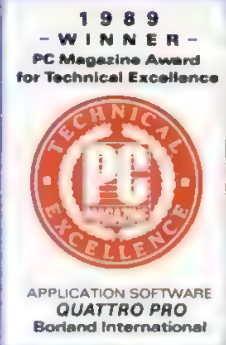
NEW

A new color scanner, from **NCL America Computer Products**, promises to add a lot of reds and blues and purples to your images—without removing a lot of green from your wallet.

The \$495 unit, called the **ClearScan Color Scanner**, provides three different brightness levels for inputting up to 256 different shades

CONTINUES ON PAGE 59

BORLAND'S NEW SPREADSHEET



THE BALANCE OF POWER: QUATTRO® PRO

	QUATTRO PRO*	Lotus 1-2-3* v 2.2	v 3.0
PUBLISHING			
3-D Graphs	✓		
Built-in draw package	✓		
Individual cell font control	✓	✓	
Shading and borders	✓	✓	
Print graphs & spreadsheets side-by-side	✓	✓	
CONSOLIDATION			
Multiple spreadsheet windows	✓		✓
Multipage consolidation	✓		✓
Keyboard and mouse support	✓		
Lotus 1-2-3 v 2.01 compatibility	✓	✓	✓
Spreadsheet Capacity (NSTL) **	640K RAM 11 1Mb RAM 18	8 12	NA 5
Price***	\$495	\$495	\$495

*Clip art from PicturePaks™ by Marketing Graphics Inc. (MGI)**NSTL (National Software Testing Labs) measured spreadsheet capacity by counting how many years of data could be added to a spreadsheet. Large numbers mean greater capacity. Performance for v 2.2 is with Always attached.
***Based on suggested retail prices as of October, 1989.

"QUATTRO PRO seems to do the impossible: It maintains compatibility with 1-2-3; adds functionality that no version of 1-2-3 has and still runs large spreadsheets in 640K."

PC WEEK, September 4, 1989

"Borland squeezes such features as multipage consolidation, advanced linking, and live graphics into a package that runs on 512K systems with its Virtual Real-Time Object-Oriented Memory Manager (VROOMM™) technology."

InfoWorld, September 4, 1989

QUATTRO PRO, with a unique balance of power, does both advanced publishing and multipage consolidation.

Lotus 1-2-3's Release 2.2 cannot do both. Neither can their Release 3.0 (see comparison chart).

QUATTRO PRO is compatible with 1-2-3.* It comes with a built-in draw package, clip art library,* and Bitstream® typefaces for presentation-quality output.

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BORLAND

CODE: MQ35

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CIRCLE 377 ON READER SERVICE CARD

"I have a lot of programs on my hard disk, from a lot of vendors - but no other firm is represented by five titles. And no other utility vendor delivers as much value to my kind of computing as Personics."

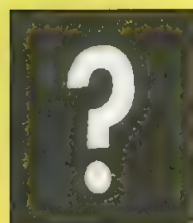
Jim Seymour
PCWeek
January 30, 1989



UltraVision
Unlock the hidden power of your EGA or VGA display.



SeeMORE
See more rows and columns in 1-2-3 or Symphony. Now with windows and graphs!



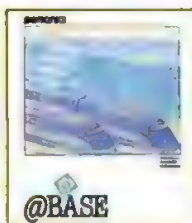
Coming soon.



Look&Link
Build giant multi-sheet applications in 1-2-3.



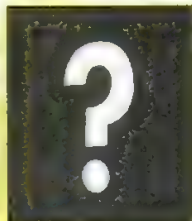
SmartNotes
Attach notes on-screen. Like 3M Post-it Notes™ for your PC.



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Use smart colors and ratio analysis to reveal hidden trends in 1-2-3.



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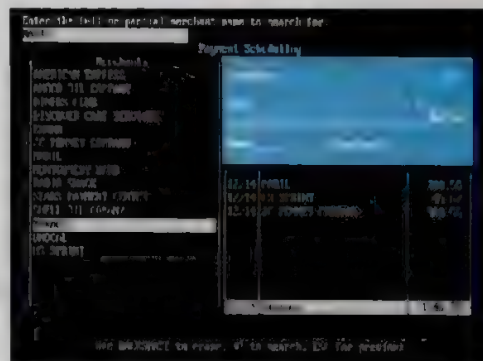
New & Improved

IMPROVED

CONTINUED FROM PAGE 54

new agreement between Zale and Spectra Publishing has resulted in the release of an upgraded version of the product. *Turbo Basic*, Version 2.0, which is also known as *PowerBasic*, offers specific features aimed primarily at developers of financial, database, and other numeric-intensive applications. The improved package offers several new data types, including BCD fixed and floating point, which provide 18-digit accuracy in financial calculations. Extended-precision (80-bit) floating-point and quad-word (64-bit) integer types are supported, as well. *PowerBasic* also enables developers to construct user-defined data structures or records during the execution of a program. In addition, new string-handling capabilities (including VERIFY, REMOVE, REPLACE, EXTRACT, TALLY, MIN, and MAX functions) are now included, and all available RAM can be used for string space (as opposed to the 64K limit in the previous release). To manipulate data, a SORT verb, complete with collating options and tag-along pointers, is also provided. *PowerBasic* is available for \$109.95. Registered owners of *Turbo Basic*, Version 1.1, can receive the upgrade for \$50 plus shipping and handling. Spectra Publishing, Sunnyvale, Calif.; (415) 730-9291.

CheckFree, Version 2.0—An enhanced version of CheckFree Corp.'s electronic bill-payment software, *CheckFree*, Version 2.0, allows for multiple budget categories and split transactions. For example, payment to a credit card can be split into categories, such as entertainment, clothing, and travel. In addition, the improved telecommunications module supports comm ports 1, 2, 3, and 4 and offers auto-redial. The new release also features an alpha search capability, so users need not scroll through an entire list of merchants to find the one they wish to pay. Transactions in the checkbook register can also be archived to a file and records automatically backed up. *CheckFree*, Version 2.0, retails for \$29.95. Registered owners of Version 1.17 can obtain the upgrade free of charge. CheckFree Corp., Westerville, Ohio; (800) 882-5280, (614) 898-6000.

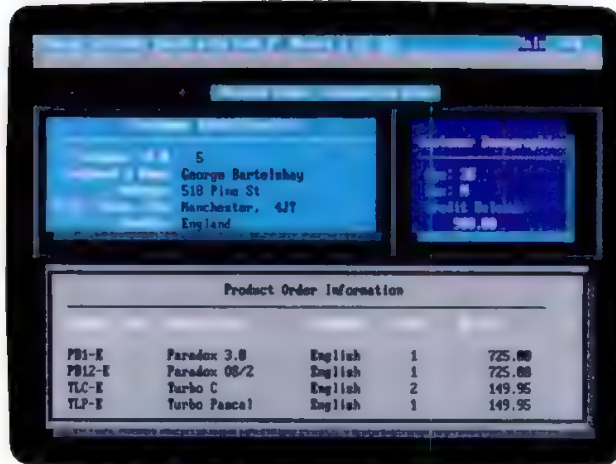


In *CheckFree*, Version 2.0, a search feature helps the user find the merchant he wishes to pay.

RollerMouse—The RollerMouse trackball, from CH Products, now supports *Microsoft Windows/286* and *Windows/386*. The unit is compatible with *Windows/286*, Versions 1.0, 2.03, and 2.11; *Windows/386*, Version 2.11; and OS/2 1.0 or later and DOS 2.0 or later. The unit retails for \$169.95. A PC-bus version is also available for \$189.95. Current RollerMouse owners can receive the necessary firmware upgrade free of charge. CH Products, San Marcos, Calif.; (619) 744-8546.

VGA-TV II and VGA-TV GE/O—Following up on its VGA-TV graphics adapter, which allows VGA output to be displayed on an ordinary television, Willow Peripherals offers two enhanced cards, the VGA-TV II and the VGA-TV GE/O. The VGA-TV II board is auto-switchable between 8 and 16 bits. It also can output higher resolutions to video than its predecessor: 720 by 480 in up to 256 colors, and 768 by 483 in up to 256 colors. The VGA-TV GE/O board, while including all the features of the VGA-TV II card, also provides genlocking and overlay capabilities to the PC, allowing users to synchronize and overlay PC graphics on live video. The board features a writable key register that enables users to pick any one of 256 possible background colors for the video to show through. For NTSC mode, users have the choice of color-kill and noninterlaced output. If video input is cut off, the output will automatically revert to standard NTSC output. Both boards include software drivers for *Microsoft Windows*, *GEM*, *AutoCAD*, *AutoShade*, *Lotus 1-2-3*, and Version 5.0 of *WordPerfect*. VGA-TV II retails for \$795, VGA-TV GE/O for \$895. Willow Peripherals, Bronx, N.Y.; (800) 444-1585, (212) 402-0010.

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You don't have to be a programmer to have easy access to our highly sophisticated, powerful relational database, Paradox® 3.0.

Paradox 3.0 is all-powerful and never painful because it makes all the complex inside moves, you don't. While it does the complex for you, the complexity is hidden beneath clear, natural, even intuitive pathways and patterns that make life easy for you.

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✓ "Query-by-Example" for example

Use this checkmark and you're using QBE.

It's that easy. Let's say you need to know in a hurry which of your Los Angeles customers bought more than 5 pairs of white shoes. First ✓ the customer field, then type "LA," "white," and ">5," and you're done. Paradox gives you the right answer, right now. And how much programming to do all that? Zero.

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Code: MX15

spreadsheet is the only program you've used before, Paradox gets you up and running immediately with just a ✓.

Record-locking and Auto-Refresh make the network safely network

Paradox has become the leading networker because it handles multiple users intelligently. If someone in your group or network has accessed a record, automatic record-locking keeps everyone else from changing it.

That way, two or more people can't change the same data at the same time. (As a bonus, Paradox also tells you *who* is using a record at a particular instant.)

Once the record has been changed by someone in the network, *Auto-Refresh* kicks in *automatically* and updates everything. Everyone in the network is looking at up-to-the-minute information.

Paradox, for the looks of things

Presentation-quality graphics are another Paradox distinction. They give you and your work the professional look.

Paradox instantly turns your tables into graphs with

one keystroke—and in multiuser environments, with a few keystrokes your graph can show up-to-the-minute changes. Not only does everyone get the picture, they get an accurate picture.



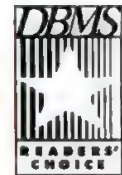
The Real Winner



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Only PreScript gives you *online printing*, letting you print without exiting your application. Only PreScript gives you WYSIWYG *preview* capability, so you can see your document on the screen exactly as it will print. Only PreScript gives you full page graphics without a printer memory requirement.

And PreScript runs up to five times faster than other solutions, particularly for graphics intensive pages and pages that switch fonts frequently. For even faster printing, an optional

PreScript interface card is available for use with the LaserJet Series II.

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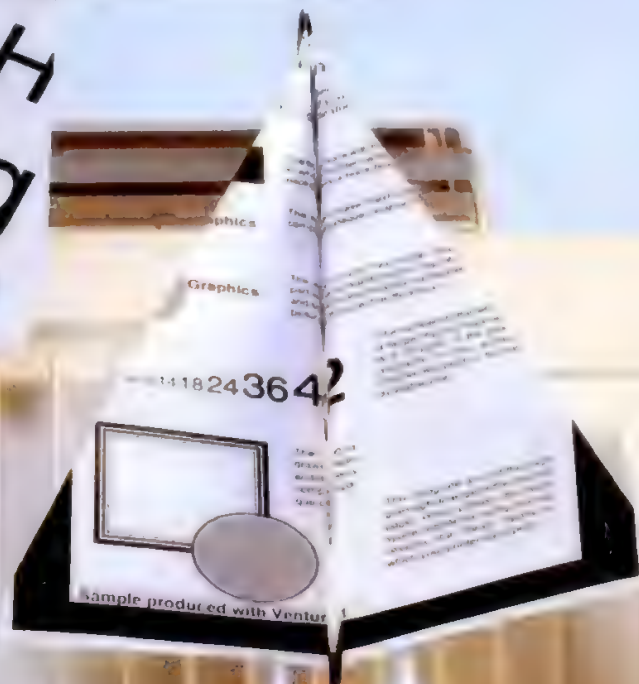
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CONTINUED FROM PAGE 54



The ClearScan Color Scanner features a 2.5-inch scanning window.

of color. According to NCL America, the scanner can read almost any color document at input resolutions as high as 400 dots per inch.

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List Price: ClearScan Color Scanner (including interface card), \$495. NCL America Computer Products Inc., 1221 Innsbruck Dr., Sunnyvale, CA 94089; (408) 734-1006.

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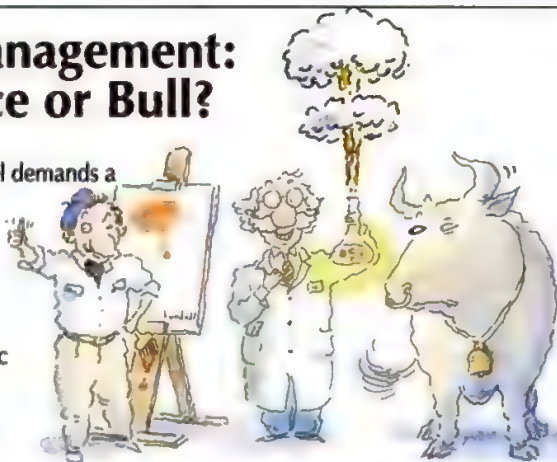
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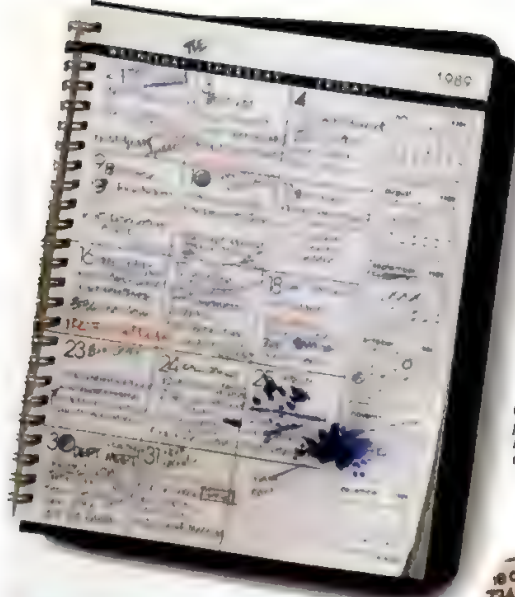
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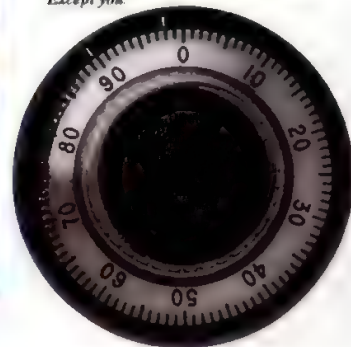


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by
Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

Database in the Works Taps All the Benefits of A Graphical Interface

The power of graphical software is evident all around. Whether it's a spreadsheet that can be manipulated with a mouse or a word processor that truly shows you what your printer will give you, applications are starting to provide some of the benefits that *Win-*

dows and OS/2 promised.

Yet the full potential of graphical software design is far from realized. 1990 is shaping up as a year when we'll start to see just how valuable graphical interfaces can be.

This summer, Microrim

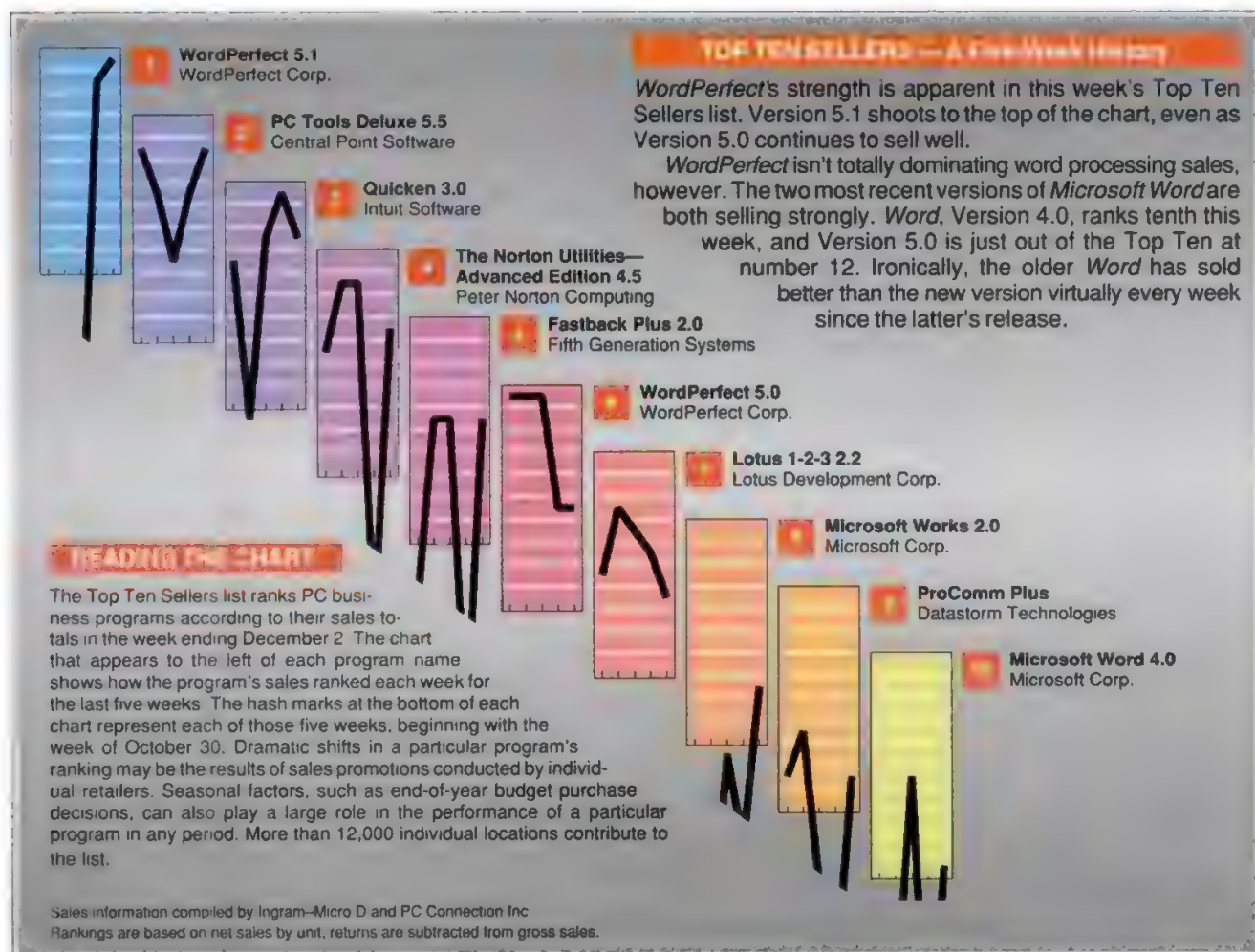
plans to ship a client-server database that combines standard relational DBMS tools with an easy-to-use application generator that makes full use of OS/2 Presentation Manager. With a few pull-down-menu choices, you'll be able to build database front-ends that outshine the best work of expert *dBASE* programmers, and you'll be able to incorporate graphics in any record.

Vanguard is the result of a massive development project

that began at Microrim within weeks of IBM's 1987 announcement of OS/2. Developed in C to be portable, *Vanguard* will run first on OS/2, and soon after it will be released for Macs, DEC VAX/VMS, IBM MVS and VM, and in several Unix versions.

Rather than enhance *R:BASE* (which runs under DOS and OS/2 in character mode), Microrim decided early on to use a completely new

CONTINUES ON PAGE 64



Pipeline

CONTINUED FROM PAGE 83

core database that could fully realize the potential of device-independent graphical platforms. Although the company will provide translators to convert *R:BASE* applications, *Vanguard* constitutes a complete break with the kind of traditional programmable database that *R:BASE* represented.

The *Vanguard* report creation toolbox, for example, consists of icons for text, dates, pictures, radio buttons, and check boxes. Entry forms don't need to be simple fill-in-the-blanks affairs; they can be designed to match printed forms, right down to the tiniest detail. Part numbers can be complemented by scanned photos, company logos can grace printed reports, and anyone can build his own menu-driven database application with a few mouse clicks.

Vanguard will form queries in ANSI-standard SQL and use a two-phase commit control. Microrim says it's willing to use the protocols that the SQL Access Group is developing (see Pipeline, *PC Magazine*, January 16, 1990), offering the promise of someday being able to query any SQL server seamlessly. Right from the start, *Vanguard* is expected to have links to OS/2 Extended Edition and *dBASE* files.

In addition, various levels of security will give database administrators an easy way to control the extent to which they allow customization of applications.

To ensure that the program's relational tools are readily accepted, Microrim has spent a great deal of its development dollars on user tests. Not content to accept SAA's common-user-access (CUA) standards as the last word in interfaces, the com-

pany appointed a director of usability, with the authority to control keystroke combinations and to guarantee that *Vanguard* had as few differences as possible across the various platforms.

For the first 18 months of development, only the data-

mable read-only memory) techniques is close to perfecting memory chips that hold their contents without power and can withstand thousands of read/write cycles.

Called ETOX (erasable tunnel oxide) or flash memory, the chips will be used in por-

Pair Computer plans to use flash memory for a portable's system BIOS, a strategy that gives users the opportunity to keep the code recent.

Psion's portable will use flash memory chips for plug-in storage cards.

Flash memory has enormous potential to become the portable PC's standard storage device, since it saves notebook PC makers from the expense of building in the extra battery backup required to keep static RAM alive.

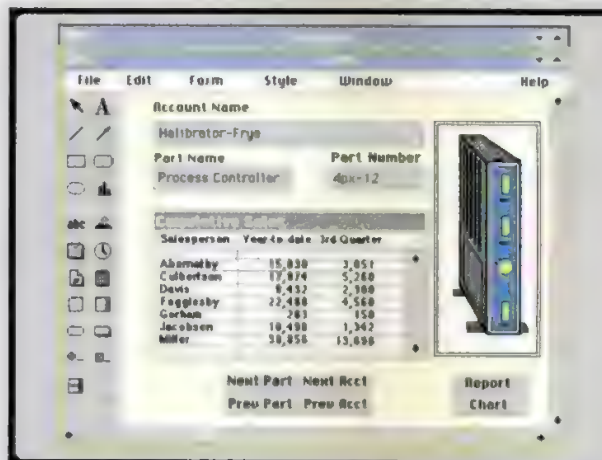
On-Line Mailing Lists a Growth Market

On-line and CD-distributed databases cover hundreds of special needs, but one of the most commonly used databases—the phone book—lags behind.

In the Northeast, NYNEX sells *NYNEX Fast Trax*, a CD that lists every published phone number within NYNEX's jurisdiction. At \$5,495 for an annual subscription, updated monthly, few people are likely to experiment with the service. That's a big loss for marketers, since search software is a powerful tool when applied to the phone directory.

A small company in Atlanta now has a modified version that's pay-as-you-go, thanks to a 900 number. The PC Yellow Pages is a database of businesses across the nation that can be queried on-line. For \$1 per minute, you can search at 1,200 or 2,400 bits per second, using ZIP code or company specialty as the criterion. Once the query has been completed, you download your list in comma-delimited ASCII format.

The service is designed to help marketers looking to compile lists, not businesspeople seeking specific information. Both types of service are likely to become huge businesses in time.



Later this year, *Vanguard* will stretch the boundaries of how a database is perceived by bringing full graphics to standard DBMS techniques.

base kernel was written. Not until the interface tests produced comments like "It's easier than *Excel*" did the programmers begin to program the surface code.

For all its innovation, though, *Vanguard* will still be judged on performance when it hits the market. And it will have to generate a lot of heat to muscle past Oracle's SQL Server, Microsoft/Ashton-Tate's SQL Server, Novell's forthcoming *NetWare 386 SQL*, and the growing roster of other products from vendors who sense a growing market in the SQL server area.

Those who are looking to graphical environments to further leverage their investment in PCs, however, are likely to find *Vanguard* one of the most promising developments of 1990.

Flash Memory Has Enormous Potential

Intel's continuing research into EPROM (erasable program-

tables due out later this year from Psion and start-up Pair Computer. The devices cost about half as much as static RAM chips.

Flash memory chips are actually slightly revised EPROMs. The basic 1970 design for the EPROM centers around a silicon gate that's insulated from electrical charges by an oxide coating in order to keep the chip's memory alive. Intel's recent experiments found that a small reduction in the amount of oxide used to insulate that gate dramatically improves the chip's capacity for reading and writing.

Flash memory requires about 2 seconds for reprogramming before data can be written, a speed comparable to floppy disk access. Reads, however, are lightning-fast—150 or 200 nanoseconds. The first uses of flash memory will be to replace EPROMs, providing more flexibility in what's stored.



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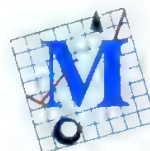


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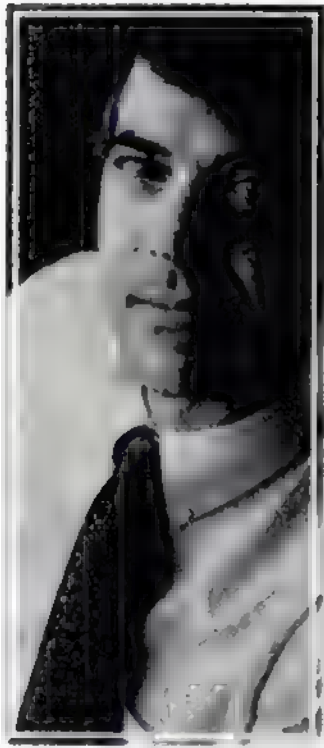


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Bill Machrone



Compaq has taken Big Blue's place as the standard-setter in the PC marketplace. Now it's starting to behave like IBM in other ways.

You've got to hand it to the folks at Compaq. They've done a masterful job of positioning the Systempro and the Deskpro 486. In one fell swoop, they've created the standard to beat in multiprocessor file servers, brought the three major network operating systems under one roof, sent a chill through the already reeling minicomputer market, and fired a warning shot across the bows of the proprietary workstation vendors. Oh, and by the way, both of them are EISA machines.

After all the hoopla that went on about EISA in the last year, you'd have expected more in the way of bus-level comparison tests, learned dissertations on the superiority of EISA over Micro Channel, and the like. Instead, Compaq is showing the best proof of all: working 32-bit EISA boards for the most-important networks from key third-party vendors. Obviously, those network vendors didn't build their new interface cards for Compaq alone. But they held their fire for the Compaq announcement rather than for, say, the Hewlett-Packard or ALR EISA rollout.

Anytime you hear the people at Microsoft talk about "our business partner," you know they mean IBM. This relationship defines and circumscribes many of the things that Microsoft does and says. Yet there was Steve Ballmer, Microsoft's top systems guy, at the Compaq rollout, telling us about this proprietary version of *OS/2 LAN Manager* they'd cooked up for the Systempro. It divides *LAN Manager* into two parts, giving the High Performance File System a processor of its own while leaving the other processor to handle I/O and server-based applications.

The next two speakers were Ray Noorda, the head of Novell, and Doug Michaels, who runs Santa Cruz Operation, arguably the best-positioned company in the Unix wars. Noorda was there to tell about the breathtaking performance the Systempro dishes up under *NetWare 386*, with each processor handling different tasks. Meanwhile, Michaels announced that SCO Unix runs symmetrically on the Systempro, meaning that the Unix kernel balances tasks between the two processors. This is a first for PC-based file servers and an important breakthrough.

Compaq's dealers have always sold networking software. They always will. While IBM was the first to offer a LAN operating system, Compaq is now the first to offer its customers a variety of approved choices. Coupled with all the codevelopment that Compaq has done on interface cards and on the custom version of *LAN Manager*, it puts the company squarely in the connectivity business. Compaq isn't just a box vendor anymore.

HISTORY REPEATS ITSELF

Fellow columnist Will Zachmann was the first to identify Compaq's new direction: "Compaq is DEC, circa 1971." Zachmann primarily refers to Compaq's position as the vibrant competitor against the entrenched forces, but there is another, more portentous similarity. Back in their heyday, minicomputer vendors were jokingly accused of pushing their systems off the back of the truck as they drove by your building. This love-'em-and-leave-'em

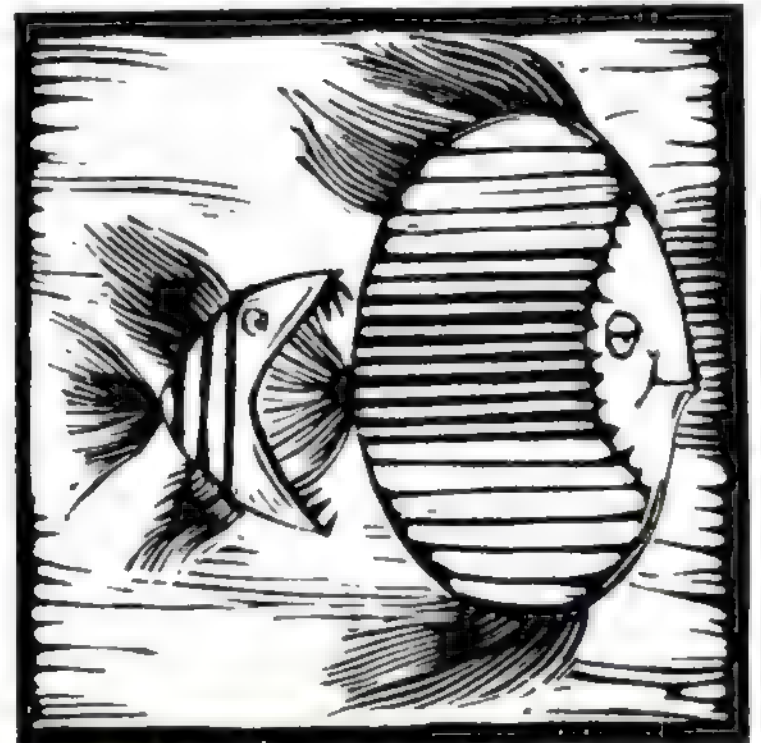


ILLUSTRATION: RAPHAEL & BOLOGNESE

form of customer support was widely decried by the mainframe vendors. The mini companies were aided and abetted in their invasion by value-added resellers. Ultimately, though, the mini vendors built their own field-support operations to help their customers overcome technical hurdles.

It remains to be seen if the major PC companies can continue to rely on VARs and sophisticated dealers to do their field work, or

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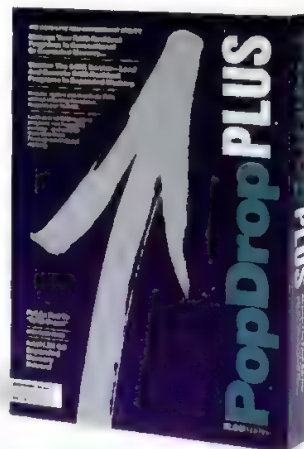
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Bill Machrone

whether they'll ultimately have to own that aspect of the business in order to maintain quality and enforce standards. PC products are geometrically more complex than in the past. Compaq currently deals with this through dealer qualification programs and extensive training. Will it be enough? VARs get an enormous chunk of money for network installation, application development, and system maintenance. Can the hardware vendors afford to leave this lucrative market alone? I predict they won't.

A LITTLE BIT PROPRIETARY

One of the motivations behind IBM's design of the PS/2 series was its realization that people were filling their boxes with other vendors' boards and disks, making for service headaches as well as lost profits. The PS/2's more highly integrated innards and utility patents make it much less inviting to option out in the aftermarket. Yet, quietly, Compaq has begun to do much the same thing over the past several years, notably by moving some of the hard disk control electronics from the controller to the drive.

Similarly, when OS/2 came out, everyone immediately suspected that IBM would come out with a proprietary version that offered benefits that would only be available on IBM hardware. OS/2 Extended Edition may have been intended to do this, but I can't find anyone who has actually been threatened or intimidated by it. The IBM version of OS/2 has become the de facto standard, and some hardware vendors even measure their compatibility by their ability to run OS/2 EE out of the box.

Now Compaq has gone and done what everyone feared IBM would do: released a proprietary version of OS/2 that gives a significant advantage to a specific hardware platform. Furthermore, Compaq has taken its disk technology a giant step forward with its drive arrays. If IBM had done it, there'd be screams of anguish. But Compaq did it, and it's cool.

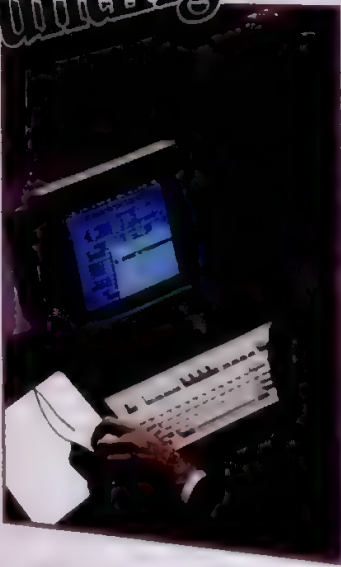
These are moves that IBM would like to have made if it didn't have a minicomputer business to protect. There is a danger in all of this for Compaq, however. It has been said that if you study your enemy too closely, you will become him. In other words, you are what you eat. ■

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**Swollen in bulk,
Comdex is so
crazy it's now
impossible to get
any work done.
But then, work
is hardly the
point, is it?**

With 120,000 attendees, Fall Comdex was the biggest show to hit Las Vegas in years. But one has to wonder if it can go on increasing in size and attendance. This year you couldn't get a car or a room unless you were on some secret list. (Dvorak hint: I made a point a few years ago of obtaining a copy of the Vegas yellow pages from the local phone company. I find it very useful for getting that last-minute car rental or finding rooms for whining friends who get bumped from the Hilton.)

Comdex lasts too long and is too spread out to be useful. Personally, I find that the Editors' Days that *PC Magazine* puts on around the country to introduce our editors to local companies are far more valuable to me as far as new products are concerned. There was little I saw at Comdex that I hadn't already seen on the road.

On the other hand, Comdex is something of a maven's delight and a social happening. You get to see guys you always promise to "do lunch" with. Another year passes, you see them at Comdex, promise to "do lunch" again, and wait another year. It seems to work. The quick meeting at the show confirms the fact that you (and the other fellow) aren't dead. Of course you never "do lunch," but neither of you probably wanted to in the first place.

Then there are the parties, where you get to meet more people that you promise to have lunch with and never talk to again. This year was the worst for such parties. I've never seen anything like it. A few years ago people were lamenting the passing of the Comdex party. Now they extend from the day before the show (unprecedented) right through the last minute (the burnout party given by Traveling Software). Each night there are at least 20 expensive parties here and there around the town, each one celebrating something or other.

So the show has taken a life of its own. If you don't go because there is no substantial reason to go, then you have to pretend you went and get people to say "you just missed him" to those who are looking for you. Otherwise people will think you (a) have gone broke, (b) are quitting the business, (c) are between jobs, or (d) have had your expense account cut. None of this is good for your career.

Super technology maven and publisher Will Hearst of the *San Francisco Examiner* has always made an appearance at the show, usually at my urging. This Comdex, he figured that the best way to do so was in a cameo role. So he flew in on a private plane, looked around the show floor, went to a couple of parties, and took the plane back at 2 A.M. Now this is not a bad approach to a show like this. Just show up and leave. Grab a catalog and a few press kits. Of course Hearst just wanted to get back early because his car was in short-term parking at SFO. Still, it creates the image of a guy who is important.

FANCY FOOTWORK

A few years ago, someone wanted to sell a service where he would go to the show and grab all the press kits and ship them to interested journalists. I thought it was a dumb idea, but now I'm not so sure. If nothing else, you can always burn them in the fireplace for cheap heat.



ILLUSTRATION: RAPHAEL & BOLOGNESE

Another possibility is to use a shill—a look-alike. Or just give your badge to someone who doesn't mind saying he's you. Andy Warhol used to send out phony Andy Warhols to speeches he gave. Comdex nearly demands a shenanigan like this.

Clearly, something has to be done to make Comdex more efficient without ruining one's image. Then again, maybe it's time we threw up our hands and just said no!

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The Worst Comdex Ever Dept.: I don't want to say that the key industry trade show, Comdex, is getting worse each

year. I'm sure that the promoters don't see it that way, since they intend to build their own convention center and have already bought one Vegas hotel with their massive profits.

The first thing I noticed this year was the crowds. I discovered that the aisles in the main hall were narrowed by 3 feet to add even more exhibitors at the premium price. My ability to maneuver through these skimpy aisles was terribly inhibited. I couldn't see as much as before because I spent too much time stopped dead in aisles jammed with naive showgoers looking in the Comdex guidebook or gawking at dopey exhibits.

Dvorak's Comdex Top Five Dept.: So what was important or interesting at the show? I always like to find the interesting and overlooked goodies in the back aisles of the faraway halls. This year, I was surprised to find many interesting things in the main hall.

Sony, for instance, had a tremendous selection of new monitors and video projectors. Obviously, Sony intends to dominate the monitor market, either with the Sony brand or by selling OEM versions of its products to computer manufacturers. But to me the most interesting thing was a prototype CD-ROM maker, which takes a new compact disk media called CD-R. Using new Sony-Philips specifications, this equipment can take a special blank disk and make a CD-ROM (or a CD audiodisk) out of it that can be put into any plain-vanilla player. The impetus behind this technology comes from the potential CD-ROM users who want to manufacture their own disks in-house for security reasons (CIA, NSA, KGB?). Over 30 slave CD burn-in units can be hooked up to one master machine.

Hitachi finally showed its 10-inch VGA color LCD. It's got one of the widest viewing angles I've seen. Nearby, the company showed a funky all-in-one VHS videotape player with one of the color video LCDs attached. This thing looked like it was from another planet.

And finally, three products from Chips and Technologies, a company whose presence was mysterious at what was supposed to be a show for computer dealers. The first was the SCAT chip—the single-chip AT; actually, the support circuitry needed for an AT. The second was an 8514 chip set that the company will sell dirt-cheap. And the third was a loaded 10-MHz PC-XT clone with 512K of memory, parallel and serial ports, a hard/floppy disk controller, and an LCD/CGA video driver, in a package a bit smaller than a deck of cards. CEO Gordon Campbell was carrying this around in his pocket. I'm told that by this time next year, the firm will

Inside Track

produce a loaded AT in an even smaller package!

One disappointment at Comdex was the continuing lack

of the perfect laptop machine. To be honest about it, Compaq has redefined the laptop business with the LTE line. But still, no company has outdone *PC Magazine's* 1988 Technical Excellence Award winner, the NEC UltraLite. It's been a year, and still we've seen nothing better or even competitive. I was depressed. This is the hottest part of the industry, and everyone misses the point.

Worse, the guys who do get the point are all using the same miserable "dome technology" no-throw keyboards. You know, the keyboards with zero key travel. The UltraLite, the Compaq LTE, and the Zenith MinisPort (among a crowd of machines suckered by this technology) all have these phony keyboards that are the worst things to hit the scene since the Chiclet keyboard. There is no tactile feedback, no key travel, and no incline. We must complain long and hard about these keyboards. They are so far removed from what we expect a computer keyboard to be that they are literally painful to use. I hear promises from a number of vendors that this will be changed soon. Let's pray!

One crowd to keep an eye on is the Brits who make the Psion. I was shown their 5-pound Psion 400 machine, and although it lacks a backlit screen, it has a fabulous high-contrast LCD and incorporates a weird pad that replaces the mouse in a unique way. Always known for interesting ideas and compact design, it was just a matter of time before Psion brought out this nifty notebook machine.

Still, the pace-setters are NEC and Compaq. One insider told me to ignore all the market research numbers about which laptop or notebook is the most popular. "While Toshiba and Zenith fight it out amongst researchers, the company that is selling these things by the carload is Compaq," he said.

But the real sleeping giant is NEC. We must never forget that NEC owns the microcomputer market in Japan with its proprietary system. The company has been reluctant to do PC compatibles until recently. But monster companies like NEC seldom allow themselves to give away the foreign dough to the Toshibas of the world. It looks bad. Letting Compaq, IBM, or any American firm dominate the American market is all very well, but letting a second- or third-ranked Japanese company beat them in the U.S. has to be somewhat humiliating for NEC. I expect to see NEC make a strong push in the next couple of years. It has the advantage of being a leading microprocessor designer; the UltraLite, you remember, carries the powerful NEC V-30 chip, not an Intel chip. So NEC doesn't have to worry about its source of supply, does it? ■

I couldn't see as much as before because I spent too much time stopped dead in the aisles.

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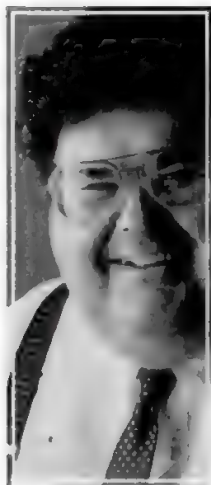
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Jim Seymour



**Too often, vendors
create products
simply because
they can. But
where's the market
for these feats of
engineering?**

Have you seen Autodesk's new *Animator* program? Wow, what a nifty product! It was clearly one of the best new offerings of 1989, and it may be one of the best software programs ever.

I was knocked out by the first demo. When I put *Animator* on my machine, I fell in love. Using it was more fun than anything I've done on a computer in years—at least, once I'd gotten past its arcane, nonintuitive interface ("Tweens"? "Tweens"?).

So I started showing the program to friends and corporate clients. They thought it was pretty whizzy, too. But they all asked the same strange, irritating question: "Who needs it?"

Oh, well. There's always *something* you overlook when you're developing a new product. Or falling in love with one.

Over the past two or three years, we've seen more and more products in what I've come to call the "because we could" category. That is, hardware and software products created not because anyone really needed them, but solely because they could be done.

Remember Cauzin Systems' Softstrip System Reader, the gizmo that read programs printed on little strips of paper, or even along the edges of magazine pages, into your PC?

Remember Felix, the mouse that wasn't—the little lump that you pushed around with your finger in the middle of a huge ashtray-like lump that was placed on the desk next to your keyboard?

Remember the Nike running shoe you could plug into your PC to gather data on your training schedule? The sneaker with the serial port in the heel?

R.I.P. And I'm sure you can make your own additions to this list.

In fairness to *Animator*, which really is good in spite of its Amiga origins and a subsequent clumsy port to the PC, it's true that a few people will find it useful. Those who contract to build elaborate desktop presentations to be shown to audiences on PC screens, for example. That's a half-dozen users right there.

Even if you don't share my view that desktop presentations won't be a very big market, you have to ask how many people who build and use desktop slide shows are going to want

to work with a tool of *Animator*'s complexity.

Disney Studios and XYZ Pharmaceuticals have very different needs. When an XYZ product manager puts together a sales pitch for his company's new miracle replacement for, say, Tagamet, he's likely to want a much quicker, simpler tool—to build a fast prototype of a show he'll hire a contractor to build for him, or to put together a few text screens for a training or test-marketing program.

He doesn't want a video animation studio on his desk; he's a product manager, not a TV director. A rich, feature-laden program, even an easy-to-use one, is likely to suck him in and absorb days of time when he ought to be doing his real job—managing the roll-out of his product.

SLENDER FOOTINGS

Production-oriented tools are for production people—of whom, in this area, there are likely to be very few.



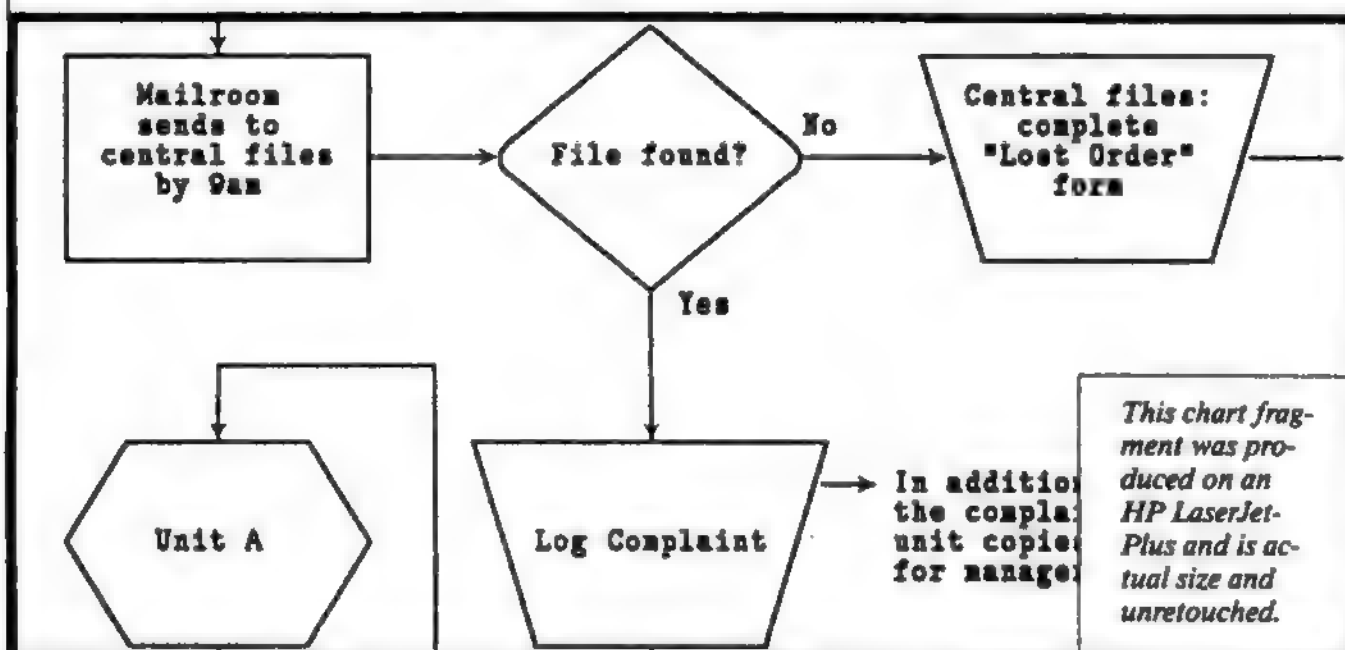
ILLUSTRATION: RAPHAEL & BOLOGNESE

That's true of virtually all of these "because we could" products. Someone needs them and will probably come to love them. But too often, there are only a very few someones out there for these products.

I feel compelled to add that vendors aren't alone in this "we did it because we could" approach. When I see truly terrible printed pieces produced by desktop publishing systems—the kind of design atrocities we like

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Jim Seymour

to post on our Desktop Publishing Wall of Shame bulletin board here at *PC Magazine*—I sometimes track them down to see who created them and why.

Most often, I find some hapless soul at a company who was asked to do the piece "because we had this copy of *PageMaker*, you know, and the boss figured that since I have a LaserJet and all"

In other words, they did it in-house and put it in the hands of someone who hadn't a shred of graphic-design training or experience because they could, not because they should.

Not long ago I was in a meeting with the senior management of a large and successful PC company. Their products are very good and their company is widely respected.

We were looking at a new 386SX portable, and the conversation moved to how quickly they could put an 80486 machine in the same case. Never mind that the 486 is such a flamethrower that everyone working with it is trying to devise heat sinks and heat shields for the chip. Never mind that some space for air circulation is essential to ventilate the chip. And never mind that this company hasn't even delivered a 486 desktop PC yet.

They could do it, by God.

Let's merrily tread down the 486 laptop lane for a while. Would you do X or Y? Would A or B be more important? Until I asked a nasty little question: Just who would buy this cute little toaster oven? Collectively, we could think of exactly two prospects. Not two companies, two people. Period.

But boy, they could do it.

COMMON SENSE

As microprocessor-based systems get more powerful, and as truly powerful software-development tools (such as the new end-user object-oriented programming languages) get easier to use, the potential for being led astray into these "because we could" products will grow exponentially.

Vendors have to resist the temptation of diverting their resources to products that are fun to build but unlikely to fill more than a few users' needs.

And users? We have the harder job of recognizing when something that's fun to use is something we probably shouldn't be using at all. ■

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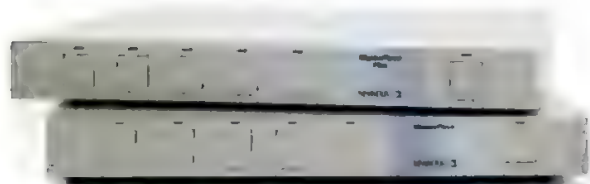
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William F. Zachmann



**The legions of
mainframe diehards
have learned nothing
and forgotten
nothing. History will
surprise them.**

Mainframe machismo appears to be in fashion again. You remember the old "If it ain't a mainframe, it ain't a real computer!" creed of the old-line MIS/DP types—and its corollary that if it isn't a mainframe application, it isn't a real application.

Fight or flight, according to the researchers, are the two genetically programmed responses to a perceived threat. The most recent wave of mainframe machismo, which has every appearance of a fight response, takes the form of printed attacks on those who are supposedly overselling the utility of micro-based systems. It vigorously asserts that mainframes are here to stay because they are the only way to handle big applications.

At the same time, it is also a flight response because it flees from the realities of technology and economics—and from the marketplace in which the two meet. It refuses to address the real issues while pretending to win an imaginary battle against illusory enemies.

An editorial in *Computerworld* last fall (October 23, 1989) fired the first shot in the current skirmish. *Computerworld* and others jumped on the announcement of Digital Equipment Corp.'s large-scale VAX 9000 and Tandem's Cyclone line as evidence of a mainframe revival. Since then, others have taken up the banner, claiming that the world isn't really changing much after all and that it will continue to be business as usual where big mainframe iron is concerned. Mainframe machismo has become a mini fad.

But in the end, it adds up to little more than the bellowing of the doomed dinosaurs as they discover that the air is tougher to breathe, the climate is cooling, and their swamps are drying up. Unable in reality to either fight or flee, they engage in nothing more than empty posturing.

The arguments advanced by mainframers to further their cause are directed against straw men of their own invention, rather than against the reality that obviously distresses them so. They trivialize the overwhelming arguments for microprocessor-based systems, reducing them to the absurd contention that every application can be run on personal computers. This completely ignores the reality of larger and more powerful microprocessor-based systems.

Of course, if you define the word *mainframe* as any large system, then you can argue that mainframes are here to stay. But that amounts to nothing more than an assertion of the obvious. Merely pointing out that there are large-scale applications in the real world that will continue to require large-scale systems to run on is not an argument for the survival of the mainframe at all.

SPLITTING HAIRS

What defines a traditional mainframe is not simply its size and capacity. Its proprietary architecture, proprietary operating system, proprietary networking protocols, and proprietary application software lead inevitably to the semi-monopoly pricing that is an inescapable part of its operation.

Large systems based on multiple standard microprocessors are significantly different from mainframes. Though similarly designed to handle huge databases, transaction volumes, and



processing loads, they are built from standard components and run standard operating systems. As a result, they can offer price/performance ratios that are much closer to those of their personal-computer cousins than to traditional mainframe and minicomputer systems.

The mainframe camp often responds to this fact by trotting out some obsolete DP types who have their rectangular-shaped pale-blue heads stuck firmly in the sand and can be

William F. Zachmann

counted on to say something really stupid like "There's no way I'm gonna replace my 3090s with those weird little things." This is supposed to prove that corporate America isn't about to entrust its data processing to newfangled micro-based systems.

What's missing from the picture is the fact that those very same data processing managers, directors of information systems, and so-called chief information officers are the ones who really have been getting replaced lately. In fact, it's been happening at an appalling rate. The old-style DP weeklies like *Computerworld* and *MIS Week* have testified to a steady stream of executive outplacements from the IS ranks in recent years.

The primary reason for this trend has been corporate America's growing dissatisfaction with the results achieved for the money spent on corporate information systems. Information systems executives who refuse to replace their expensive mainframes with less costly microprocessor-based alternatives are simply inviting their own replacement—anyone who's dumb enough to insist on solving problems with \$100,000 mainframe MIPS when they could be solved with \$1,000 micro MIPS is just begging for a new career in consulting. Just because the mainframe camp can persuade a few of these people to accelerate their own demise by making dumb statements in public is hardly an argument for a mainframe revival.

NOT PROVEN

The fact that vendors like DEC and Tandem have introduced larger mainframe-class systems in recent months proves nothing, either. Neither the VAX 9000 series nor the Tandem Cyclone is exactly a traditional mainframe. Both of them offer price/performance ratios that are considerably better than those of the traditional mainframes from IBM.

These new systems represent, in effect, an intermediate stage between the mainframes of the past and the microprocessor-based systems of the future. Success for DEC and Tandem will have to come at the expense of established mainframe vendors like IBM. If these systems gain acceptance, they will merely pave the way for even more aggressively priced and even less traditionally designed systems built around standard microprocessors.

Let's hope the macho types enjoy their brief moment in the spotlight! They aren't too likely to do much harm to anyone but themselves, and they may help clarify things for those too dumb to know that the micro revolution doesn't just mean personal computers.

When all is said and done, the recent wave of mainframe machismo will be remembered—if it is to be remembered at all—as little more than a small eddy in the current that is carrying the industry into a new era. It's nothing but the cry of those who don't seem able to either fight or flee. For the rest of us, the replacement of traditional systems offers a challenging task whose rewards will easily outstrip those available to the mainframers determined to pass into extinction. ■

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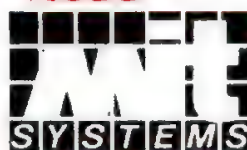
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Standard Features

	XT-10	286-12	386SX-16	386-20	386-25
CPU	8088	80286-12	386SX-16	80386-20	80386-25
Speed (MHz)	10/4.77	12/6	16/6	20/8/6	25/8/6
Bios	ERSO	Phoenix	AMI	Phoenix	Phoenix
Norton SI Rating	2.1	13.4	19.01	23.0	30.5
Wait State	0	0	0	0	0
Standard Memory	640K	1 MB	1 MB	1 MB	1 MB
Shadow Memory	-	-	-	64 K	64 K
Cache Memory	-	-	-	32 K	32 K
Co-Processor Slot	Yes	Yes	Yes	Yes	Yes
Expansion Slots (8 bit)	8	2	2	2	2
Expansion Slots (16 bit)	-	8	6	5	5
Expansion Slot (32 bit)	-	-	-	1	1
FD/HD Controller	W/HD	Yes	Yes	Yes	Yes
Device Bays	4	3	3	5	5
Serial Ports	-	2	2	2	2
Parallel Ports	-	1	1	1	1
Game Port	-	1	1	1	1
Clock/Calendar	Yes	Yes	Yes	Yes	Yes
Power Supply	150 W	200 W	200 W	200 W	200 W
Keyboard	101 Key	101 Key	101 Key	101 Key	101 Key
Floppy Drives	1	1	1	1	1



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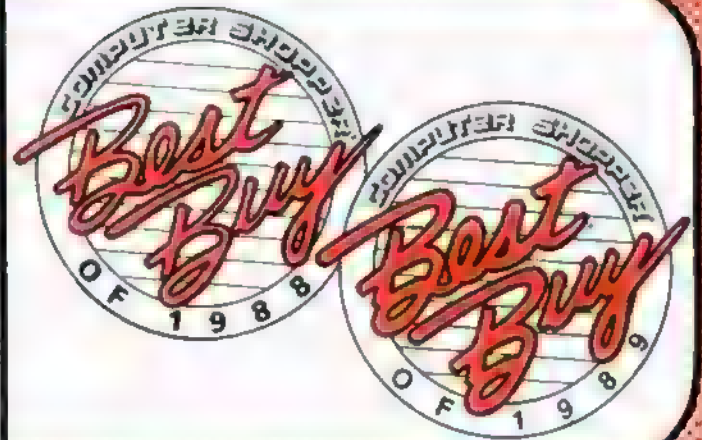
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Stephen Manes



When you want to find something on a CD-ROM, you've got to use the software that comes with it. But there's a move afoot to let you find things your way.

PC Magazine proudly announces its new "flexible" format: beginning next issue, the table of contents will appear on a page numbered by the formula $(VN \cdot IN) \text{ MOD } 420$, where VN is the volume number and IN is the issue number. The First Looks section will be distributed throughout the magazine on pages whose numbers are determined by a secret method based on the New York Lotto's selections for the previous Saturday. Fear not, loyal reader: you'll always find this column seven pages after the advertisement that contains the most white space.

Not true. A fib. But that's just the sort of irritation CD-ROM users must contend with every time they shove a new disk in the drive. Here in my office, I've got review copies of maybe two dozen compact disks, no two of which work exactly the same way. The retrieval software, bundled with and essential to each disk, is different for virtually every one; in fact, it can even vary among products from a single vendor. Admittedly, consistency hasn't been one of the computer industry's strong points, but the situation here is ridiculous. It's as though you had to learn a new word processor system every time you wrote about a new topic.

So far the CD-ROM is confined mostly to the world of reference works, catalogs, and service manuals. Ask any librarian who has scrounged enough funds for more than one disk: inevitably, he or she has had to learn a new user interface for each one. No wonder librarians tend to keep CDs behind the desk and perform searches themselves rather than letting users do it. It's just too hard to teach users all the ins and outs of the dozens of different schemes.

The problem becomes even worse in a data-intensive business such as aerospace. Since, as industry lore has it, the documentation for an airplane can be as large as the plane itself, CD-ROM technology seems perfectly suited for this kind of data. But if you're the maintenance director at Leadballoon World Airways, your fleet is likely to include an assortment of planes from various manufacturers. If the information is supplied on CD-ROM, it's a safe bet that your mechanics will be obligated to learn a different method of

retrieving the information on each vendor's disk. Result: a potential productivity gain turns into an unnecessary time-waster.

FREE AND WORTH IT

There's a growing sense among potential and actual CD-ROM users that the data on a disk should be in some way independent from the software used to retrieve it. This is precisely the opposite of the current situation where the data comes alive only with the retrieval software that's tossed in for free (and usually worth about that much).

It's reasonable to think that standardization would be good for the data vendors, too. After all, it was an agreement about the low-level encoding and layout of data on the disks, originally known as the High Sierra format and now formalized as ISO 9660, that got CD-ROM off and running (though slowly). Along with Microsoft's CD-ROM Extensions, the ISO standard meant that software could address the CD-ROM as just another drive.



But ISO 9660 remains silent on the question of how to structure the data. Every vendor uses a different proprietary scheme, just as every word processor creates files in its own proprietary format. The difference is that if somebody sends you a *WordPerfect* file, you can go out and buy something that will read or convert it. When it comes to CD-ROMs, you're usually stuck with the less-than-stellar software you've been handed.

Stephen Manes

Enter the aerospace industry, which has begun to flex its muscles to speed the adoption of the standards it deems desirable. Most recently, it pushed for the adoption, in this country, of the X.400 electronic mail interchange format developed by government-owned European national telecommunications monopolies. Some competitive American e-mail vendors originally looked upon X.400 as a slippery slope leading to the commoditization of their industry. But since those American vendors can't afford to write off a market as potentially huge as aerospace, they've begun to fall into line behind the X.400 standard.

The same thing might happen with SFQL (Structured Full-Text Query Language), a standard for electronic document delivery on CD-ROM that is currently under development by a working committee of the AIA (Aerospace Industry Association) and ATA (Airline Transport Association). If it sounds vaguely familiar, it ought to: SFQL adds what the

popular SQL standard leaves out—a mechanism for retrieving information from unstructured full-text documents. When finalized, the SFQL standard should also include some sort of mechanism for accessing graphics, along with the ability to access structured SQL databases.

DOING THE SCUT WORK

SFQL uses what industry jargon calls a client-server model. What this means is that a CD-ROM database would come with back-end retrieval software designed to process standard queries from users and to retrieve the relevant information from the database. The front-end software would contain the user interface, plus the client code that passes properly formed queries to the server. Since the back end would take care of the scut work of finding the data and decompressing it in a standard, dependable way, the user could design (or buy) any kind of front-end software to work with this standardized back end.

This sounds like nirvana for users who routinely need information from more than one CD-ROM. Learn one user interface, and you could access any SFQL-standard

disk. There'd be no worry (as there is now) about which software to use when accessing a bunch of different CD-ROMs on a network: one front end would fit all.

The concept of separating the data from the software that ultimately retrieves it is so important for users that it ought to carry the day. Still, opposition to standards is only to be expected. Just as the barrier-breaking X.400 electronic-mail standard (and its companion, the X.500 directory standard) pushes electronic mail down the road to becoming a commodity like long-distance phone service, separating data from retrieval is likely to commoditize the retrieval-engine business, opening it up to competition on such terms as quality and price. Vendors who offer neither may protest.

SFQL may not be the only way, or even the best way, to separate the innards of the database cat from its user-interface skin. But something like it has got to free us from the tyranny of proprietary data-linked CD-ROM retrieval software—and maybe, down the road, from the tyranny of proprietary on-line retrieval software as well. As usual, freedom of choice beats take-it-or-leave-it all hollow. ■

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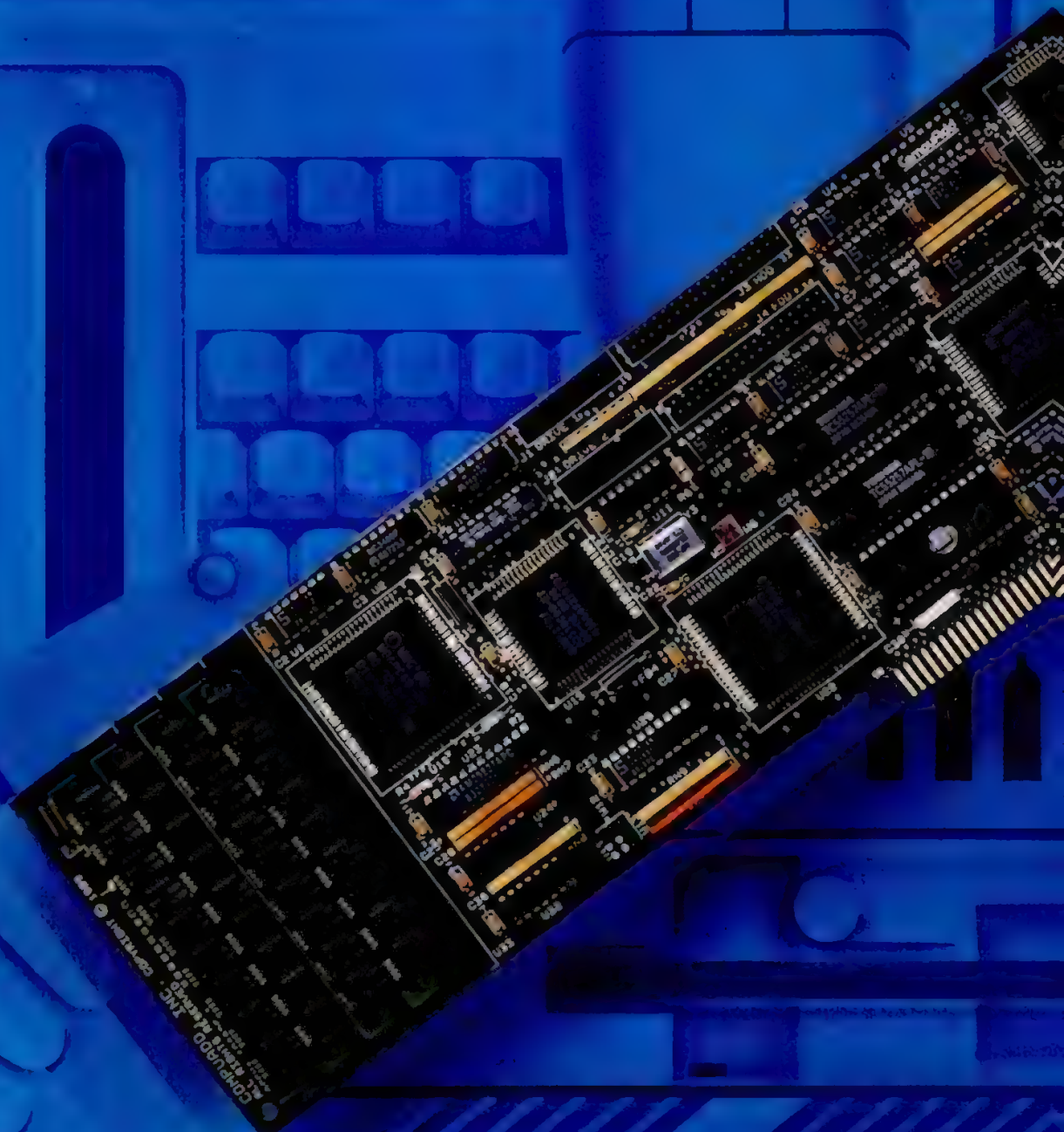
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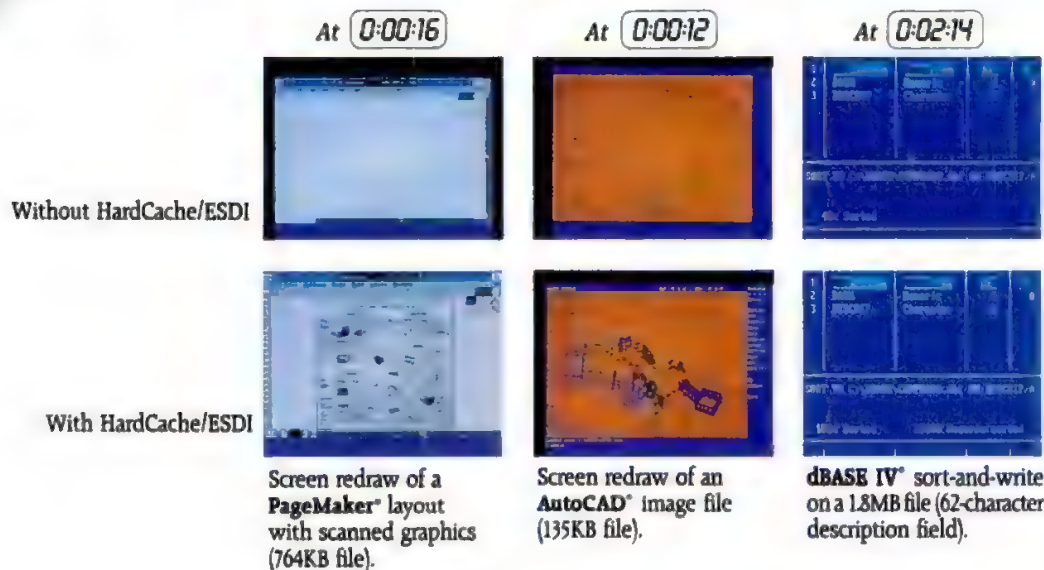
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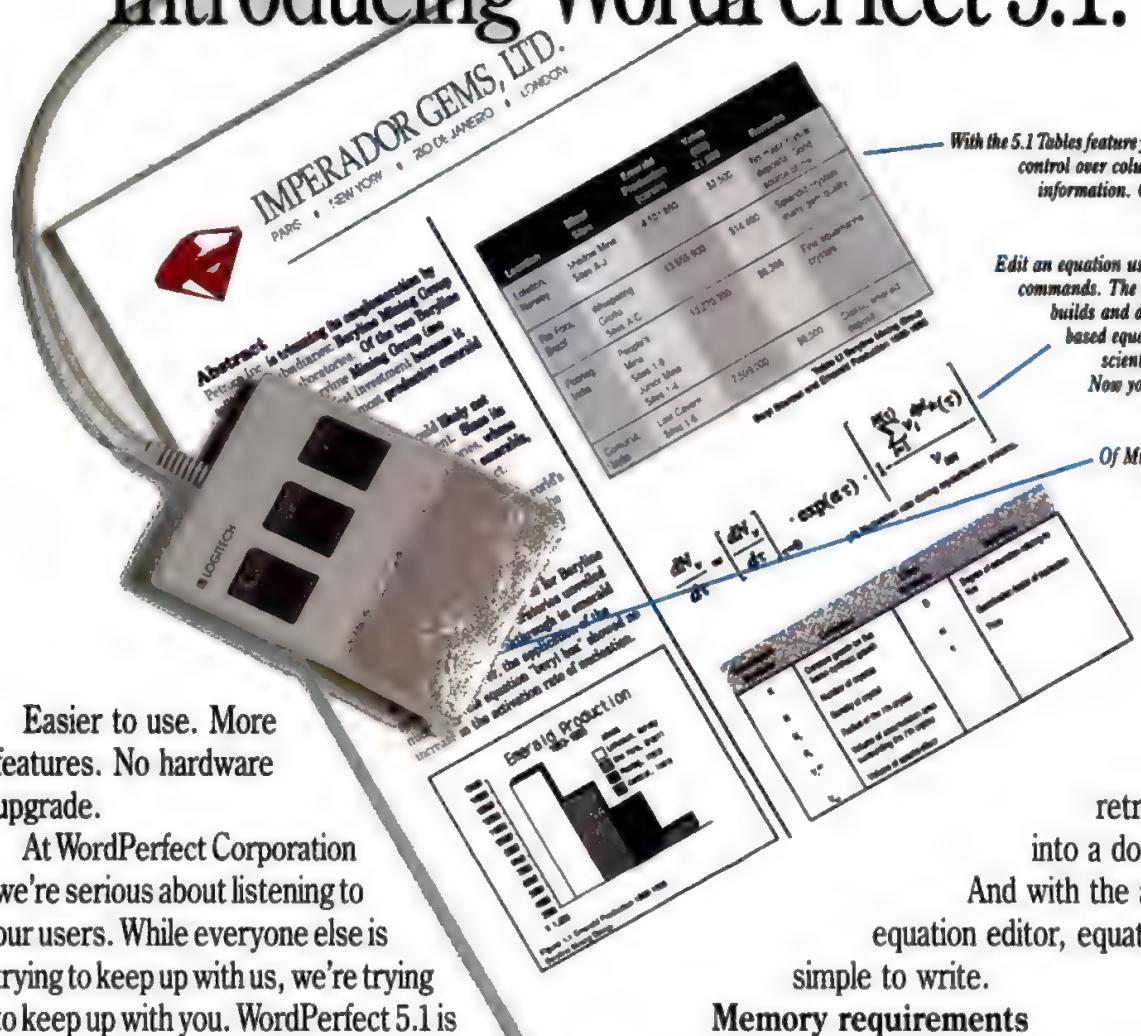
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SPEED TO RIAR

22 of the Fastest 386s

by Alfred Poor

Our second look at the 33-MHz 386 PC unveils 22 new entries with sophisticated design and all the speed you need. If you thought the 486 would unseat the top-velocity 386 almost before its reign began, think again.

Wherever there are sand piles, kids are playing “King of the Hill”—battling to see who can reach the high ground and hold it against all comers. The PC market is not much different, except that it’s played on a pile that keeps growing taller, and new heights are reached faster and faster as time passes.

Exactly one year ago, *PC Magazine* ran a cover story on the fastest PCs ever. The article chronicled the first 25-MHz 386 computers to enter the market, and at the time it was written, there were only nine machines to review.

As we pointed out in that article, the development cycle for new machines is getting shorter. The next

generation of 33-MHz designs hit the market so fast that this is our second survey of these machines in a matter of months. The first feature article appeared in the October 31, 1989 issue, with reviews of 22 computers, and this issue's crop includes 22 more that have come on the market since then.

How can it be that in 12 short months, the market leaped from fewer than ten 25-MHz machines (and no 33-MHz models) to nearly 50 33s?

According to some sources, this phenomenon is a result of improved engineering. A number of the 33-MHz motherboards are not simply cloned versions of slower boards, but are new designs. Some manufacturers were working on their 33s well before they even had 25s on the market. This advance work meant that once the chips became available from Intel in sufficient quantity in early 1989, the floodgates were ready to open with the latest in high-performance models.

And the market was ready and waiting. Certainly, these hypercharged wonders are more than you need if you're just running a word processor or some simple applications. But there are many reasons to go for the extra performance besides simply having the latest and fastest technology.

WHERE DO THE 33-MHz 386s ROAM?

The 33-MHz PCs are finding welcome homes in a number of areas. CAD and desktop publishing applications that make heavy demands on processor power get a much-needed boost from a CPU running nearly a third faster than 25 MHz. The extra speed these computers pack also makes a significant difference in large database and LAN server applications. Many of the machines that we tested for this article offer features that cater to one or more of these market segments.

Manufacturers clearly view this group as top-end workhorses and configure them accordingly. There were lots of 1-megabit SIMM modules installed in these machines, and many are ready for the 4Mb SIMMs once they become available in quantity. Banks and banks of RAM DIP sockets are rapidly becoming history in the ever-accelerating PC market.

We also found more memory on disk controllers than in the past; many machines came with intelligent controllers that make use of either buffers or on-board caching to boost disk performance significantly. And many vendors do not offer low-end hard disks with these models.

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You can expect to find base models that start with 100MB or larger drives as standard equipment, and most of these drives rely on an ESDI or SCSI interface for better performance.

RIDING A DIFFERENT BUS

There are some interesting developments in the bus designs as well. As of this writing there is still no standard 32-bit bus for AT-style (ISA) machines, but a few designers used the Intel 32-bit slot on their boards. This construction can accept standard 8-bit or 16-bit boards in addition to 32-bit cards. And while 32-bit slots are still primarily used for memory cards, we found at least one 32-bit disk controller card in this batch of machines. Engineers are clearly looking for ways to boost performance by taking advantage of a 32-bit-wide data transfer path to gain faster access to components other than just system memory.

For the features section of this issue, the associate editor was Stephanie K. Losee, and the PC Labs project leader was Robert W. Kane.

Modifications can even be found on the standard bus slots. Some vendors have decided to abandon the standard AT-bus speed of 8 MHz. (See Winn L. Rosch's sidebar, "The 8-MHz Bus: Time for a Change?", October 31, 1989, page 109.) DataWorld is one, choosing instead to run at an accelerated 11 MHz. This can cause problems for older expansion cards, but will mean better I/O performance with cards designed to be driven at this higher speed.

Despite the flood of products and the commodity pricing that increased competition generally brings, these 33-MHz machines do not come cheap. The "low-end" prices range between \$5,000 and \$6,000, and you can easily top \$20,000 list prices for full-blown models from big-name vendors.

How much do you pay for this extra speed? Compare prices within a vendor's 386 line. If you were to buy a 386 from Compaq with 2MB of memory, color VGA display, and an 84MB hard disk, the list price would be \$11,198 for the 33-MHz model, \$9,996 for the 25-MHz, and \$7,996 for the 20-MHz version. While there are some differences in the designs of these three models, the 33-MHz machine still represents a whopping 40 percent price increase over the 20 MHz and is 12 percent more expensive than the equivalent 25-MHz machine.

Toward the lower end of the list price scale, Austin Computer Systems offers 33-MHz 386 computers with 1MB of RAM, color VGA, and a 110MB hard disk for \$4,695 and 20-MHz models for \$3,495. Like some other vendors, Austin has dropped its 25-MHz model altogether, since the company feels that there isn't enough room for two top-end machines in its product line. The price spread from 20 MHz to 33 MHz is about the same in proportion to Compaq's prices: a 34 percent increase. If these premiums seem a bit high, remember that on a price-to-speed comparison, the 33s come out looking like good bargains compared with their slower siblings.

PUBLIC ENEMY NO. 1: THE FUTURE?

Understandably, many buyers are going to pause before they shell out top-dollar prices for the thirtysomething speed crowd. Potential customers are likely to be concerned about what lies just over the horizon. Already we have seen the first arrivals of 80486 systems and EISA bus machines. The 486 holds forth the promise of

ACER AMERICA

Acer 1100/33

by Stephen W. Plain

still greater performance; despite its 25-MHz speed, its high level of integration and self-contained cache mean that it should outpace the faster 33-MHz 386 designs. And the EISA bus could mean access to new 32-bit expansion options in the future while still accommodating the existing 8-bit and 16-bit designs for now.

Worry not, however: even industry analysts seem to agree that it will be some time before either of these developments will be much of a factor in the marketplace. Recently uncovered bugs in the 486 will be corrected by the time this issue hits the street, but the production delay this will cause is sure to put a hitch in delivery schedules. And compared with the jump from a 25-MHz to a 33-MHz 386 motherboard, both 486 and EISA motherboard designs require a lot of entirely new research and engineering. All of these factors are likely to slow delivery of new machines, and it will probably take a while before they reach the pseudocommodity status already reached by the 33-MHz 386 machines reviewed here.

And more machines are announced every day. Models from American Mitac, Charles River, Precision Systems, Swan Technologies, Tandon, and Wells American were not available at the time of this review. Arnet offers a multiuser system that is not a traditional DOS machine but can

You would guess that with over a million systems shipped, Acer would have to be doing something right. One look at Acer's top-end 386 system, the Acer 1100/33, confirms that expectation. Priced at \$10,365 with 4MB RAM, a 100MB hard disk, a 5.25-inch 1.2MB floppy disk drive, and VGA, the Acer is certainly one of the more costly machines in the 33-MHz class, but it is a system full of worthy components attractive to anyone shopping for a solid, dependable 386.

One of the first aspects of the Acer that attracts attention is the 32K maximum processor RAM cache. Unlike many other 386 manufacturers entering into the 33-MHz market, Acer has been able to produce performance equal to or better than the competition while using only half the cache size of most other high-performance systems. 32K of 25-nanosecond static RAM was sufficient to place Acer near the top of the performance heap.

The unit that PC Labs tested came with 6MB of 80-ns. RAM packaged in four

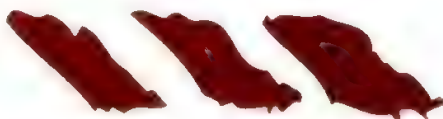
The motherboard handles up to 8MB on-board, as well as 16 additional megabytes on a proprietary memory board which fits into one of the two 32-bit slots. In addition to the processor RAM cache, the 1100/33 gains speed with the capability to shadow the system and video BIOS into higher-speed system memory. Available processor speeds are 33 MHz, 8 MHz, and "smart," which slows down the system when reading or writing to a diskette for compatibility reasons. Two sets of DIP switches on the motherboard, accessible via a rear panel, allow the user to switch the serial ports between primary and secondary and to set other system options.

The beige desktop unit has front panel controls with the flush power button on the bottom and the membrane reset switch, drive indicator, and speed indicator grouped in the upper-left portion of the unit, next to the keyboard lock. The system unit measures 7 by 21 by 17 inches (HWD) and comes with an Acer-manufactured keyboard that is clicky but responsive. The keyboard cable, extendable from the back of the keyboard at the left, right, or center, can stretch to 78 inches.

Acer ships its units standard with MS-DOS 3.3; *Microsoft Windows/386*, Version 2.1; Acer's setup program; disk cache software; and EMM driver, as well as its System Environment Manager, which al-



These high-speed 33-MHz 386 powerhouses have scrambled to the top of the heap and look as if they stand a good chance of staying there for a while.



run DOS applications by using Unix and Xenix. Reviews and features table columns for this issue's gang of 22 machines are arranged in alphabetical order.

So if you need the power, now is a good time to grab it. These high-speed powerhouses have scrambled to the top of the heap and look as if they stand a good chance of staying there for a while. It's crowded at the top, but for now, the 33-MHz 386 remains king of the hill.

SIMM modules, a 91MB Micropolis 1353A ESDI interface hard disk, the standard Acer integrated controller handling the single 1.2MB floppy disk drive, a DTC ESDI hard disk controller, and a 16-bit Video Seven FastWrite VGA board. Two serial ports and one parallel port are available on the motherboard. The Acer 1100/33 also came with the Microsoft-compatible Acer 6710 serial mouse, and an Acer 7015 multiscanning monitor.



This \$10,365 33-MHz 386 system is an example of solid construction and good design. The Acer 1100/33 achieved some of the best performance numbers on the PC Labs benchmark tests while using only 32K of cache memory. Attention to detail and quality components make this a system for the long haul.

PHOTOGRAPH BY THOMAS COOK

FACT FILE

EDITOR'S CHOICE

Acer 1100/33

Acer America, 401 Charcot Ave., San Jose, CA 95131; (800) 782-1155 (Calif. only), (800) 538-1542 (outside Calif.), (408) 922-0333.

List Price: With 4MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, Microsoft-compatible mouse, DOS 3.3, *Microsoft Windows/386*, cache and memory manager software, \$7,895; with 94MB ESDI hard disk, VGA monitor, \$9,965; with multiscanning monitor, \$10,365.

In Short: The Acer 1100/33 is made of quality components and packaged attractively; it also comes with excellent documentation. Although a costly choice, Acer may be a wise one given its excellent warranty and on-site service availability.

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lows command-line control of shadowing, caching, and processor speed.

Acer's one-year warranty, which includes four months of on-site service by TRW as well as service from Acer-approved service centers, makes its units appealing to users concerned about service downtime. The quality components of the Acer 1100/33 certainly make it a high-end system worthy of serious consideration.

AT&T COMPUTER SYSTEMS

AT&T 6386E/33 Work Group System

by Bill O'Brien

To describe the AT&T 6386E/33 Work Group System simply as a tower would be to grossly understate the true dimensions of its enclosure. No other computer arrived at PC Labs on a skid. And while its height and width are within range of most other towers, no other case is long enough to let you play handball against its side.

But if this \$12,095 Brodingnagian takes the Bigfoot award for its external appearance, inside is where the story begins to unfold. Slide back the case, and you'll find a box within a box. Interlocking metal panels keep stray RF interference from entering the world at large, and the panels themselves are ribbed with sealing strips that contact the outer shell when it's in place. Apparently AT&T is serious about meeting FCC requirements.

Underneath the shielding lie eight half-height drive bays—one 8-bit and seven 16-bit—two 32-bit slots, and an 80386 moth-

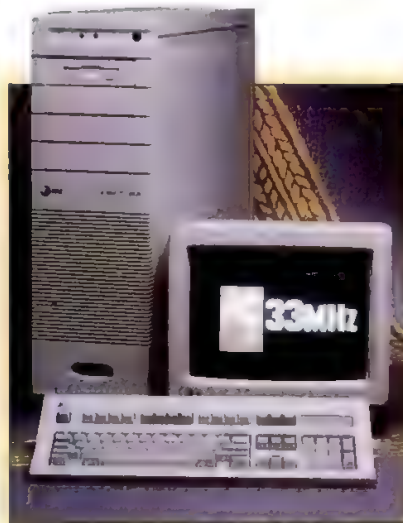
erboard instructed by a Phoenix BIOS. AT&T's switch from its one-time partner Olivetti to Intel isn't the surprise here, but the motherboard is. One of the first things you'll notice is the high chip count. There are no VLSIs on this board. Rather, much like an ice cream cone twice dumped in sprinkles, the motherboard is covered with small, discrete logic components.

Somewhat surprising is the processor RAM cache controller. There isn't one, or at least the Intel cache controller you'd expect to find on an Intel motherboard is nowhere in sight. Here too, discrete logic has taken over the work of a high-tech device.

Luckily, this bottom-line approach to technology doesn't restrain the computing power of the 6386E/33 WGS at all. A bank of 25-nanosecond static RAM chips helps catapult the computer into the top 20 percent of the machines tested.

Disk activity isn't as supportive of that processing potential as it might be. The 145MB ESDI drive, a stout-hearted performer, gets no assistance from its controller card and only manages to hang the 6386E in the middle of the crowd. It simply can't hold its own against the high-tech caching controllers in other machines when handling small records.

The large-record test results that typically negate cache buffers do no more than bump the 6386E/33 WGS into the top half of all of the machines tested. This is unfortunate because, of the machines equipped with caching controllers, only National Micro System's box comes close to the 6386E's processor performance. And even among the machines without disk caching hardware, the majority of those



FACT FILE

AT&T 6386E/33 Work Group System

AT&T Computer Systems, 1776 on the Green, Morristown, NJ 07960; (800) 247-1212.

List Price: With 4MB RAM, 135MB hard disk, 1.44MB floppy disk drive, one parallel and two serial ports, DOS 4.01, \$12,095; with monochrome monitor, \$12,350; with VGA monitor, \$13,443.

In Short: A potent machine with hooks into the networking and alternate OS worlds, but one that may not be the best candidate for the economy-minded single user.

CIRCLE 396 ON READER SERVICE CARD

coming in ahead of the 6386E's large-record handling results lag behind it in processing times.

Video times are also on the conservative side, making the AT&T VGA card as middle of the road as possible. Keep in mind that these results are garnered with shadow video turned off. With shadowing on, its speed will increase; moreover, the actual extent of the increase, compared with that of many other computers with shadowing enabled, should be slightly greater than average because of the 6386E's faster processing environment.

If you're looking for solid performance—at a premium—and support and service from a large company like AT&T, then this could be your machine.

BLACKSHIP COMPUTER SYSTEMS INC.

Blackship 386/33

by Catherine D. Miller

The Blackship 386/33 is a good example of the type of computer infiltrating the ranks of all classes of personal computers. By combining quality off-the-shelf parts, Blackship Computer Systems has successfully created a system offering good performance at a good price.

Our \$6,889 Blackship 386/33 test unit was housed in a reasonably sturdy 5.5- by 21- by 16.5-inch (HWD) desktop case. Its

The \$12,095 AT&T 6386E/33 Work Group System tower model is excellent as a server for LAN and Unix networks. The gigantic case offers plenty of interior room for expansion, including eight half-height drive bays and eight open expansion slots, as well as 4MB RAM, a 135MB hard disk, VGA, and DOS 4.01.

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33-MHz 386 COMPUTERS: SUMMARY OF FEATURES

Price of standard configuration To allow price comparisons, our standard configuration includes 4MB RAM, at least a 100MB hard disk, one high-density floppy disk drive, color VGA video display, at least one parallel and one serial port, a keyboard, and DOS. In some instances, manufacturers do not offer the exact configuration that *PC Magazine* requested, but all 22 of the PCs reviewed here offer a reasonably close match to this list of requirements. Check each machine's fact file for a more exact indication of what is included in the quoted price.

Case type indicates whether each computer has a small-footprint, desktop, or tower design.

386 chip set manufacturer indicates which company is making the support logic that connects the CPU with the other functions managed by the system board. Chip sets that use VLSI technology (very large-scale integration) reduce the discrete component count, which in turn helps to reduce power consumption and increase component life.

The system RAM arrangement is the method by which memory is addressed. Remember that CPU speed is usually faster than conventional memory speed.

Interleaved memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

Page-mode memory allows back-to-back memory accesses within blocks of memory called pages, thereby avoiding wait states.

Row/column is the traditional method of accessing data at a memory address. In this system, RAM is mapped as a matrix and a particular address is given using a row and a column number.

In **static-column** memory, once data is located at a specific column address, subsequent pieces of data are accessed or allocated to the same column. Because the column is "static," data retrieval is faster.

Wait states On the average, most machines run at between zero and one wait state. The figures printed here were supplied by the respective manufacturers.

Maximum installable RAM Separate rows indicate the maximum 32-bit memory possible on the motherboard and on a dedicated memory board, as well as the maximum size of the processor RAM cache.

RAM packaging (and rated speed) Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs.

The **dual in-line package (DIP)** is the

traditional buglike computer chip sprouting 8, 14, 24, 40, or more metal legs (evenly divided between right and left sides).

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection. Similar to SIPs are **ZIPs (zig-zag in-line packages)**, in which every other pin connection is slightly offset, creating a zig-zag pattern.

Single in-line memory modules (SIMMs) are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates installation and replacement.

Chip size Kb and Mb refer to kilobits and megabits, respectively. Combination chips (4x256Kb) are generally faster and more expensive.

Processor RAM cache A processor RAM cache acts as a bridge between the CPU and the slower main memory. The cache comprises a small bundle (typically 32K to 128K) of fast SRAM chips. The cache controller is designed to predict and retrieve the data the CPU is likely to require next, thus preventing wait states. There are two varieties of controllers: discrete logic chips (designed by the individual manufacturers) and VLSI chips like the Intel 82385.

The **BIOS version and date** can affect the PC Labs benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Setup can reside either on a floppy disk or in ROM.

Shadowing Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed at the cost of 384K of memory from the first 1MB of system RAM. The ability to disable shadowing is important with some applications to resolve memory conflicts.

Bus speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 MHz. Note that the Micro Channel bus operates at 14.5 MHz.

The **display circuitry location** can be either on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled it prevents upgrades.

Interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

Software available For DOS, OS/2, and *Microsoft Windows/386*, the version number and list price are given. DOS 3.3 or 4.01 is automatically included as part of *PC Magazine's* standard configuration for computers.

Disk caching software Some companies include software to facilitate data retrieval from the hard disk. This software speeds overall system performance by anticipating what data the processor will need next.

An **expanded memory manager** is software that emulates the Lotus Intel Microsoft (LIM) expanded memory manager within the extended memory of a 386 or 386SX PC.

Switchable settings on the power supply are designed to permit a computer's use in both the United States and Europe.

Number of device connectors indicates how many internal storage devices the system can support without the use of Y-cables (power splitters).

Hard disk options The number of different hard disks the vendor offers for a machine often indicates how much customizing is available. We listed what we believe are the most popular disk choices (100MB, 120MB, 300MB, 600MB, or the vendors' closest available models).

Within the 386 PC environment, the three most common hard disk interfaces are **ST-506**, **SCSI (small computer system interface)**, and **ESDI (enhanced small device interface)**. ST-506 uses one of two data encoding methods: **RLL (run length limited)** and the older **MFM (modified frequency modulation)** scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. The MFM format uses nine such bits to store the same amount of data that RLL can store with only six polarity changes.

Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers. A new interface that offers good performance at a lower price than ESDI or SCSI is **IDE (interface design enhancements)**.

FCC certification class Two classes of FCC (Federal Communications Commission) approval, Class A and Class B, may be given to computers. Class A approval signifies that a computer has sufficiently low radio-frequency emissions for operation in a business locale. The more stringent Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

CONTINUES

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We weren't surprised. After all, the AST Premium 386/33 offers exceptional performance in a feature-packed, stylish chassis.

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REPORT CARD

INFO WORLD

	AST Premium 386/33	COMPAQ DESKPRO® 386/33
CPU speed	Excellent	Excellent
Expandability	Excellent	Excellent
Hardware compatibility	Excellent	Excellent
Documentation	Excellent	Good
Technical support	Very Good	Unacceptable
Value	Good	Satisfactory
Final Score	8.5	7.1

Source: InfoWorld, July 24, 1989



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CIRCLE 738 ON READER SERVICE CARD



33-MHz 386 COMPUTERS: SUMMARY OF FEATURES

Products listed in alphabetical order by company

	 Acer America Acer 1100/33	AT&T Computer Systems AT&T 6386E/33 WGS	Blackship Computer Systems Inc. Blackahp 386/33	C ² Micro- systems Inc. C ² 386/33	Club American Technologies Club AT Model 333C	CSS Laboratories Inc. CSS MaxSys
Price of standard configuration	\$9,965	\$13,443	\$5,190	\$5,745	\$4,954	\$6,420
TESTED CONFIGURATION						
Case type	Desktop	Tower	Desktop	Tower	Desktop	Tower
Dimensions (HWD, in inches)	7.0 x 21.0 x 17.0	25.5 x 7.8 x 29.4	5.5 x 21.0 x 16.5	24.8 x 7.0 x 16.5	7 x 21.125 x 16.75	25 x 7.5 x 16.5
Motherboard manufacturer	Acer	Intel	Micronics	AIR Industries	Club AT	CSS Laboratories
386 chip set manufacturer	Intel	Intel	Chips and Technologies	Chips and Technologies	Club AT	CSS Laboratories
System RAM arrangement	Page mode	Interleaved, page mode	Page mode	Interleaved, page mode	Page mode	Page mode
Wait states	0	0	0	0	0	3
MOTHERBOARD MEMORY						
Installed RAM	6MB	4MB	N/A	N/A	2MB	N/A
Maximum installable RAM	8MB	8MB	N/A	N/A	2MB	N/A
RAM packaging (and rated speed)	SIMM (80 ns.)	SIMM (100 ns.)	N/A	N/A	DIP (80 ns.)	N/A
Chip size	4x256Kb; 1Mb	1Mb	N/A	N/A	256Kb	N/A
ADD-IN MEMORY BOARD						
Installed RAM	None	4MB	4MB	4MB	2MB	4MB
Maximum installable RAM	16MB	16MB	16MB	16MB	8MB	8MB
RAM packaging (and rated speed)	SIMM (80 ns.)	SIMM (100 ns.)	DIP (80 ns.)	SIMM (100 ns.)	SIMM (100 ns.)	DIP (100 ns.)
Chip size	1Mb	1Mb	1Mb	256Kb, 1Mb	256Kb	1Mb
PROCESSOR RAM CACHE						
Cache controller	Intel 82385	Intel 82385	Intel 82385	Intel 82385	Discrete logic	Intel 82385
Installed RAM	32K	64K	32K	32K	64K	64K
RAM packaging (and rated speed)	DIP (20 ns.)	SIMM (35 ns.)	DIP (25 ns.)	DIP (25 ns.)	DIP (20 ns.)	DIP (20 ns.)
Chip size	4x4Kb	16x4Kb	64Kb	32Kb	8x8Kb	4x256Kb
Maximum installable RAM	32K	64K	64K	32K	64K	64K
BIOS						
BIOS version and date	Award BIOS 3.03E2 (September 1989)	Phoenix BIOS 1.15 (August 1989)	Phoenix BIOS 1.10 10 (January 1988)	AMI BIOS (March 1989)	Parcorp/AMI BIOS F1S-39 (March 1989)	AMI BIOS (3.04D) 3.0 (April 1989)
Setup in ROM	■	■	■	■	■	■
Password in ROM	□	■	□	□	□	■
System shadowing/Can be disabled	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
Video shadowing/Can be disabled	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
HARD DISK						
Manufacturer	Micropolis	Maxtor	Maxtor	Maxtor	Maxtor	Imprimis
Disk capacity	94MB	135MB	158MB	158MB	170MB	106MB
Interface	ESDI	ESDI	ESDI	SCSI	ESDI	ESDI
Controller location	Card	Card	Card	Card	Card	Card
Controller manufacturer	Acer, DTC	Western Digital	Western Digital	Adaptec, Ultrastor	National Computer	Adaptec
Integrated floppy/hard disk controller	□	■	■	■	■	■
Drive bays (height)	5 half	4 half	5 half	7 half	5 half	5 half
FLOPPY DISK DRIVES						
Type	1.2MB	1.44MB	1.2MB	1.2MB	1.2MB	1.2MB
Manufacturer	Matsushita	Panasonic	TEAC	TEAC	TEAC	TEAC

■ — Editor's Choice ■ — Yes □ — No

N/A — Not applicable; this product has no memory on the motherboard.

Dataworld Dataworld Data 386-33 \$5,767	Destiny Computers Destiny 386-33 \$6,595	DTK Computer Inc. DTK Keen-3304 \$7,399	Eltech Research Inc. Eltech Model 9970 \$5,485	Fortron/ Source NetSet 333 \$5,250	HIMS Technologies Inc. HIMS Cache Pro 386/33 \$5,995	Micro Express Micro Express ME 386-33LC \$4,993	Micro 1 Inc. Micro 1 Power 386/33 \$5,790	National Micro Systems Inc. Flash 386-33 \$6,242
Tower	Tower	Tower	Desktop	Tower	Tower	Small-footprint	Tower	Desktop
24.5 x 7.5 x 16.25	24.5 x 23 x 9	21.125 x 7 x 17.062	6.5 x 21.5 x 16	24 x 6.5 x 18.5	7 x 21.125 x 16.75	6.75 x 14.75 x 16	24.5 x 7.5 x 16.75	6.25 x 20.5 x 16.5
Micronics	Micronics	DTK	Eltech	AMI	HIMS	Micronics	Mylex	Micronics
Chips and Technologies Row/column	Chips and Technologies Row/column	DTK Interleaved, page mode	Eltech Page mode	Chips and Technologies Static-column	HIMS Page mode	Chips and Technologies Interleaved	Chips and Technologies Interleaved, page mode	Chips and Technologies Static-column
0	0	0	0	0	0	0	0	0
4MB 16MB DIP (80 ns.) 1Mb	None 32MB DIP (70 ns.) 1Mb	4MB 8MB SIP (80 ns.), DIP (80 ns.) 1Mb	4MB 8MB SIMM (80 ns.) 1Mb	4MB 8MB DIP (70 ns.) 1Mb	4MB 8MB SIMM (80 ns.) 1Mb	N/A N/A N/A N/A	2MB 32MB SIMM (80 ns.) 1Mb	4MB 8MB DIP (80 ns.) 1Mb
4MB 16MB DIP (80 ns.) 1Mb	4MB 8MB DIP (80 ns.) 1Mb	None 8MB SIMM (80 ns.) 1Mb	N/A 8MB SIMM (80 ns.) 1Mb	None 16MB DIP or SIMM (70 ns.) 1Mb	8MB 8MB SIMM (80 ns.) 256Kb, 1Mb	4MB 16MB DIP (80 ns.) 1Mb	8MB 32MB SIMM (100 ns.) 1Mb	4MB 8MB DIP (80 ns.) 1Mb
Intel 82385	Intel 82385	PALS	Discrete logic	Discrete logic	Discrete logic	Intel 82385	Discrete logic	Intel 82385
64K DIP (25 ns.) 8x8Kb 64K	32K DIP (25 ns.) 8x8Kb 64K	64K DIP (25 ns.) 64Kb 256K	256K DIP (20 ns.) 64Kb 256K	64K DIP (15 ns.) 64Kb 64K	256K SIMM (20 ns.) 64Kb 256K	32K DIP (25 ns.) 32Kb 64K	128K DIP (20 ns.) 64Kb 128K	64K DIP (35 ns.) 64Kb 64K
Award BIOS 3.04 (June 1989)	Phoenix BIOS 1.10 10 (1989)	DTK BIOS 4.25 (June 1989)	AMI BIOS (March 1989)	AMI BIOS (April 1989)	AMI BIOS F1S (February 1989)	Phoenix BIOS 1.10 10a (January 1989)	Phoenix BIOS 1.10.08 (January 1989)	Phoenix BIOS 1.10 07 (January 1989)
■ □ ■ / ■ ■ / ■	■ □ ■ / ■ ■ / ■	■ □ ■ / ■ ■ / ■	■ □ □ □	■ □ ■ / ■ ■ / ■	■ □ □ □	■ □ ■ / □ ■ / ■	■ □ ■ / ■ ■ / ■	■ □ ■ / ■ ■ / ■
Siemens 320MB ESDI Card PSI	MiniScribe 150MB ESDI Card Western Digital	Maxtor 160MB ST-506 Card DTC	Imprimis 150MB ESDI Card Western Digital	MiniScribe 150MB ESDI Card Western Digital	Maxtor 150MB ESDI Card DTC	Imprimis 150MB ESDI Card DTC	MiniScribe 330MB SCSI Card Mylex	CDC 150MB ESDI Card DPT
■	■	■	■	■	■	■	■	■
3 half	10 half	7 half	5 half	1 full, 4 half	10 half	5 half	10 half	5 half
1.2MB, 1.44MB Sony, TEAC	1.2MB, 1.44MB TEAC	1.2MB Fujitsu	1.2MB TEAC	1.2MB, 1.44MB TEAC	1.2MB, 1.44MB Mitsumi, TEAC	1.2MB TEAC	1.2MB, 1.44MB TEAC	1.2MB TEAC

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33-MHz 386 COMPUTERS: SUMMARY OF FEATURES

Products listed in alphabetical order by company

	Oak Micro- Systems Ltd. Oak Micro- Systems D386/33/4	Olivetti USA Olivetti M380/XP9	PC Craft Inc. PC Craft 5000/33C	PC Max PC Max PM 386-33/M	Spear Technology Inc. Spear 386/33U	Ultra-Comp Computer Hardware Ultra-Max 386-33	Zeos International Zeos 386/33
Price of standard configuration	\$6,769	\$12,495	\$12,250	\$5,000	\$4,700	\$5,995	\$5,882
TESTED CONFIGURATION							
Case type	Small-footprint	Tower	Tower	Desktop	Tower	Tower	Tower
Dimensions (HWD, in inches)	6.5 x 14.75 x 16.25	22.375 x 11.25 x 26	24.5 x 7.25 x 16.25	6.75 x 20.5 x 16.25	25.25 x 7.5 x 16.5	21 x 7 x 17	25.5 x 9.5 x 18.75
Motherboard manufacturer	Hauppauge	Olivetti	Mylex	Micronics	Spear	Micronics	AMI
386 chip set manufacturer	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	Spear	Texas Instruments	Chips and Technologies
System RAM arrangement	Interleaved, page mode	Static-column	Interleaved, page mode	Interleaved	Direct-map	Static-column	Row/column
Wait states	0	0	0	0	0	2	0
MOTHERBOARD MEMORY							
Installed RAM	4MB	4MB	N/A	N/A	N/A	N/A	4K
Maximum installable RAM	4MB	8MB	N/A	N/A	N/A	N/A	8K
RAM packaging (and rated speed)	DIP (80 ns.)	SIMM (100 ns.)	N/A	N/A	N/A	N/A	SIMM (70 ns.)
Chip size	4x256Kb	1Mb	N/A	N/A	N/A	N/A	256Kb, 1Mb, 4Mb
ADD-IN MEMORY BOARD							
Installed RAM	16MB	8MB	4MB	4MB	4MB	4MB	None
Maximum installable RAM	64MB	56MB	32MB	16MB	16MB	16MB	8K
RAM packaging (and rated speed)	DIP (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	DIP (80 ns.)	DIP (80 ns.)	DIP (80 ns.)	DIP (70 ns.)
Chip size	4Mb	1Mb	1Mb	1Mb	1Mb	1Mb	256Kb, 1Mb
PROCESSOR RAM CACHE							
Cache controller	Intel 82385	Intel 82385	Discrete logic	Intel 82385	Intel 82385	Intel 82385	Discrete logic
Installed RAM	64K	32K	128K	64K	32K	32K	64K
RAM packaging (and rated speed)	DIP (15 ns.)	DIP (15 ns.)	DIP (20 ns.)	DIP (25 ns.)	DIP (25 ns.)	SRAM (25 ns.)	DIP (25 ns.)
Chip size	64Kb	16Kb	64Kb	32Kb	8Kb	8x8Kb	64Kb
Maximum installable RAM	64K	32K	128K	64K	32K	64K	64K
BIOS							
BIOS version and date	Award BIOS 3.03a, 3.04 (September 1987)	Olivetti BIOS 1.07 (March 1989)	Phoenix BIOS 1.10.08 (June 1988)	Phoenix BIOS 1.10 10a (January 1988)	Phoenix BIOS 1.10 10a (January 1988)	Phoenix BIOS 1.10 10a (January 1988)	AMI BIOS DAMI 3607 (April 1989)
Setup in ROM	■	□	■	■	■	■	■
Password in ROM	□	■	□	□	□	□	□
System shadowing/Can be disabled	■ / □	■ / □	■ / ■	■ / ■	■ / ■	■ / ■	■ / □
Video shadowing/Can be disabled	■ / □	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
HARD DISK							
Manufacturer	MiniScribe	NEC	Micropolis	Toshiba	Toshiba	MiniScribe	CDC
Disk capacity	155MB	300MB	135MB	144MB	150MB	150MB	337MB
Interface	ESDI	ESDI	ESDI	ESDI	ESDI	ESDI	ESDI
Controller location	Card	Card	Card	Card	Card	Card	Card
Controller manufacturer	DPT	Western Digital	DPT	National Computer	DTC	Western Digital	DPT
Integrated floppy/hard disk controller	■	■	■	■	■	■	■
Drive bays (height)	3 half	3 half	6 half	5 half	3 half	5 half	6 half
FLOPPY DISK DRIVES							
Type	1.2MB, 1.44MB	1.2MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB
Manufacturer	Mitsumi, TEAC	Toshiba	TEAC	TEAC	TEAC	TEAC	TEAC

■ — Editor's Choice ■ — Yes □ — No

N/A — Not applicable: this product has no memory on the motherboard.

CONTINUES

80386/33 processor operates at 6, 8, or 33 MHz. Although the Micronics motherboard supports a turbo switch, the case doesn't, and the processor's speed is adjusted via software. A front-panel LED lamp indicates when the processor is running in 33-MHz turbo mode.

The back of the case has three 25-pin and two 9-pin I/O port cutouts. For some reason our test unit's one parallel, one game, and two serial ports used one 8-bit and one 16-bit slot rather than using the cutouts.

Three of the five half-height drive bays are accessible from the front panel; four can be used to accommodate two full-height devices. A 1.2MB 5.25-inch TEAC floppy disk drive occupied one half-height bay, while Maxtor's full-height 158MB ESDI hard drive occupied two. A 16-bit Western Digital WD1006 controller, capable of handling two hard and two floppy disk drives, supported both devices.

The Blackship 386/33 relies on a 32-bit memory card for all system RAM. Our test unit came with 4MB of page-mode RAM consisting of 80-nanosecond 1-megabit DRAM chips in DIP packaging; the card supports a maximum of 16MB.

On the system board, 64K of 25-ns. SRAM chips in DIP packaging make up a 32K static RAM cache controlled by the Intel 82385/33. The expansion bus, which sports one 8-bit, five 16-bit, and one proprietary 32-bit slot, runs at 11 MHz. To change the bus speed to 8.1 MHz, you must adjust the DIP switch on the motherboard.

VGA graphics are supplied by a Paradise Plus 16-bit VGA board with a 15-pin



At only \$5,190, the Blackship 386/33 furnishes all you need for 33-MHz 386 computing. Featuring a Micronics motherboard, the system supports up to 16MB of 32-bit memory on a dedicated memory board and optional daughterboard.

C² MICROSYSTEMS INC.

C² 386/33

by Bruce Brown

One of the best 33-MHz 386 computer buys is the C² 386/33, sold only through authorized dealers. C² Microsystems is happy to custom-configure systems with just about any combination of components you specify, and at a price that won't blow your socks off.

The C², with 4MB RAM, a 158MB Maxtor hard disk, an ATI Wonder-16 video card with mouse, a NEC MultiSync 3D monitor, and MS-DOS 4.01 lists for just \$5,745. You can specify almost anything that will fit in the case, including hard disk drives that range from 20 to 675MB.

The C² 386/33 is a tower-style computer, measuring 24.75 by 7 by 16.5 inches (HWD). If you extend the bottom swing-out legs for added stability, the width at the very bottom increases to 12.5 inches. The

The Blackship 386/33 processor, memory, and disk times were in the midrange of the computers tested, while the unit's video times proved among the fastest.

analog port connected to a NEC MultiSync 3D monitor.

The Blackship 386/33 benchmark test results were competitive for all tests. Processor, memory, and disk times were in the midrange of the computers tested, while the unit's video times proved among the fastest.

To Blackship's credit, the manual accompanying the system was a pleasant surprise. Including both a table of contents and an index, it does a thorough job of describing system setup and expansion. Micronics utilities, Phoenix setup software, and DOS 3.3 are also standard.

Blackship Computer Systems sells its systems direct and offers a one-year parts-and-labor warranty. Toll-free technical support and on-site service, offered by Blackship only in the San Francisco Bay area, add to the system's attractiveness. In addition, the company will work with its customers to customize a system to their exact specifications.

With its winning combination of quality off-the-shelf parts, the Blackship 386/33 offers solid performance at an affordable price.

case holds a maximum of seven half-height storage devices, three of which can use removable media. In order to prove that C² really means it, the company hooked seven power connectors to the 275-watt power supply.

C² uses an Air Industries motherboard. Its separate memory card takes either 256-kilobit or 1-megabit SIMM modules with 80-nanosecond memory chips, up to a system maximum of 16MB. The motherboard does hold 32K of 20-ns. RAM cache memory governed by an Intel 82385 cache controller chip, which enables the system to run at .15 wait states 85 to 95 percent of the time.

The C²'s benchmark test scores were a little slow in relation to some of the other 33-MHz computers that use faster memory chips, but overall the C²'s performance hangs in with the strongest of the 33-MHz 386s. AMI BIOS is standard, but if you prefer, you can substitute Phoenix or Award BIOS chips at no extra cost.

In addition to the 32-bit memory card slot, there are two 8-bit and five 16-bit expansion slots. Our test unit came with a Maxi-Switch 101-key keyboard with a 72-



Blackship 386/33

Blackship Computer Systems Inc., 4031 Clipper Ct., Fremont, CA 94538; (800) 877-6249, (415) 770-9300.

List Price: With 1MB RAM; 1.2MB floppy disk drive; two serial, one parallel, and one game port; utilities, \$3,195; with 4MB RAM, 120MB hard disk, VGA monitor, DOS 3.3, \$5,190; with 158MB ESDI hard disk, Paradise Plus 16-bit VGA card, NEC MultiSync 3D monitor, 80387/33 coprocessor, \$6,889.

In Short: A combination of quality name-brand components at a good price, the Blackship 386/33 turned in competitive times for all tests. Offering a one-year parts-and-labor warranty, Blackship sells direct, has toll-free technical support, and offers on-site service to customers in the San Francisco Bay area.

CIRCLE 367 ON READER SERVICE CARD



33-MHz 386 COMPUTERS: SUMMARY OF FEATURES

Products listed in alphabetical order by company

	Acer America Acer 1100/33	AT&T Computer Systems AT&T 6386E/33 WGS	Blackship Computer Systems Inc. Blackship 386/33	C ² Micro- systems Inc. C ² 386/33	Club American Technologies Club AT Model 333C	CSS Laboratories Inc. CSS MaxSys
EXPANSION BUS						
Bus speeds (MHz)	8	8, 33	8.1, 11	8	8.25, 11, 16.5	8
Expansion slots	One 8-bit, six 16-bit, one 32-bit (proprietary)	One 8-bit, seven 16-bit, two 32-bit	Two 8-bit, five 16-bit, one 32-bit (proprietary)	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Three 8-bit, seven 16-bit, two 32-bit
Slots left free after hard/floppy disk drives, video, one parallel and two serial ports are installed	5	8	3	4	4	7
Ports originate on motherboard	■	■	□	□	□	□
VIDEO						
Display circuitry location	Card	Card	Card	Card	Card	Card
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Manufacturer	Video Seven	AT&T	Paradise	ATI	MaxLogic	Video Seven
Chip set manufacturer	Video Seven	Intel	Paradise	ATI	Paradise	Video Seven
KEYBOARD						
Manufacturer	Acer	AT&T	Key Tronic	Maxi-Switch	Key Tronic	Honeywell
Number of keys	101	101	101	101	101	101
Number of function keys	12	12	12	12	12	12
Keyboard cable length (inches)	78	96	66	76	64	72
SOFTWARE AVAILABLE						
DOS	3.3 (included)	3.3, 4.01 (\$150)	3.3 (\$90), 4.01 (\$115)	4.01 (\$75)	3.31 (\$85)	4.01 (\$90)
OS/2	1.1 (\$350)	1.1 (\$340)	None	None	None	None
Microsoft Windows/386	2.1 (included), 4.01 (\$150)	2.1 (\$195)	2.1 (\$179)	None	None	None
Disk caching software	■	■	□	□	■	□
Expanded memory manager	■	□	■	□	□	□
Other	System Environment Manager	Unix V 3.2.2 (\$795)	None	Video and disk utilities	None	None
MISCELLANEOUS						
Coprocessor supported	80387 or Weitek 3167	80387 or Weitek 3167	80387 or Weitek 3167	80387 or Weitek 3167	80387, Weitek 1167, 3167	80387
PHYSICAL FEATURES						
Power supply (watts)	230	300	230	275	200	270
Switchable settings	■	■	■	■	■	■
Number of device connectors	5	6	4	7	4	6
Keyboard lock	Front	None	Front	Front	Front	Front
Case lock	None	Front	Front	None	None	Front
Power-on switch	Front	Front	Side	Front	Side	Front
Reset switch	Front	Front	Front	Front	Front	Front
Hard disk options	159MB, 338MB (ESDI); 100MB (IDE)	300MB (ESDI)	Any customer specification	350MB, 675MB (SCSI)	170MB, 380MB, 650MB (ESDI); 105MB (SCSI)	150MB (ST-506); 150MB, 300MB, 600MB (ESDI); 150MB, 300MB, 600MB (SCSI)
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
Service	4 months on-site, then return to dealer	Mail-in depot; on-site optional	Ship to manufacturer	Return to dealer	Ship to manufacturer	Ship to manufacturer
FCC certification	B	B	B	A	B	A

■ — Editor's Choice ■ — Yes □ — No

COVER STORY

33-MHz 386 PCs

Dataworld Data 386-33	Destiny Computers Destiny 386-33	DTK Computer Inc. DTK Keen-3304	Etech Research Inc. Etech Model 9970	Fortron/ Source NetSet 333	HIMS Technologies Inc. HIMS Cache Pro 386/33	Micro Express Micro Express ME 386-33LC	Micro 1 Inc. Micro 1 Power 386/33	National Micro Systems Inc. Flash 386-33
11 Two 8-bit, five 16-bit, one 32-bit	6, 11.5, 33 Two 8-bit, five 16-bit, one 32-bit	12, 6 One 8-bit, six 16-bit, one 32-bit	33 One 8-bit, six 16-bit, one 32-bit	8 One 8-bit, six 16-bit, one 32-bit	33 One 8-bit, six 16-bit, one 32-bit	33 Two 8-bit, five 16-bit, one 32-bit	33 One 8-bit, four 16-bit, two 32-bit	33 Two 8-bit, five 16-bit, one 32-bit
4	4	5	5	4	4	4	4	4
□	□	□	□	□	□	□	□	□
Card 16-bit Orchid	Card 16-bit Orchid	Card 16-bit Western Digital	Card 16-bit Paradise/ Western Digital	Card 16-bit Orchid	Card 16-bit Video Seven	Card 16-bit Paradise/ Western Digital	Card 16-bit Orchid	Card 16-bit Western Digital
Orchid	Orchid/ TsengLabs	Paradise	Paradise	Tseng Labs	Video Seven	Paradise	Tseng Labs	Paradise
Focus Electronic 101	Key Tronic 101	Key Tronic 101	Mitsumi 101	NMB 101	Focus Electronic 101	Chicony 101	Key Tronic 101	Maxi-Switch 101
12	12	12	12	12	12	12	12	12
72	60	77.5	100	20	66	75	72	61
3.41 (\$80)	3.3 (\$100)	4.0 (included)	3.3 (included)	3.3 (\$80)	4.01, 3.3 (included)	3.3 (\$75)	3.3, 4.01 (\$75)	3.3, 4.01 (\$79)
None	1.1 (\$345)	None	1.1 (\$350)	1.2 (\$299)	None	1.1 (\$275)	Contact local dealer	None
None	2.1 (386)	None	2.1 (\$150)	2.1 (\$250)	None	None	Contact local dealer	None
□	■	□	■	■	■	■	■	□
■	■	□	■	■	■	■	■	■
None	None	Info not available	QA Plus	None	Info not available	Info not available	VGA utilities; drivers	Info not available
80387 or Weitek 3167	80387 or Weitek 3167	80387 or Weitek 3167	80387	80387 or Weitek 3167	80387 or Weitek 3167	80387 or Weitek 3167	80387 or Weitek 3167	80387 or Weitek 3167
275	250	200	220	220	250 or 350	220	250	200
■	■	■	■	■	■	■	■	■
4	5	4	4	4	4	4	5	4
Front	Front	Front	Front	None	Front	Front	Front	Front
Front	Front	None	None	Front	Front	None	Front	Front
Front	Front	Front	Side	Front	Front	Front	Front	Side
Front	Front	Front	Front	Front	Front	Front	Front	Front
150MB, 320MB (ESDI); 104MB (SCSI); 104MB (IDE)	150MB, 300MB 600MB (SCSI)	120MB, 160MB (ST-506); 155MB, 335MB, 650MB (ESDI); 155MB, 240MB, 320MB, 650MB (SCSI)	150MB (ST-506); 150MB, 300MB, 600MB (ESDI); 150MB, 200MB, 300MB, 600MB, 650MB (SCSI)	150MB, 320MB, 750MB (ESDI); 110MB (SCSI)	120MB (ST-506); 150MB, 330MB (ESDI)	100MB, 336MB, 750MB (ESDI)	160MB, 330MB, 650MB (SCSI)	150MB, 300MB, 600MB, 640MB (ESDI)
1 year On-site	1 year Return to dealer	1 year Return to dealer	1 year On-site	1 year On-site	1 year On-site	2 years On-site (1 year free)	1 year On-site	1 year Ship to manufacturer
A	A	A	A	A	A	B	A	B

CONTINUES



33-MHz 386 COMPUTERS: SUMMARY OF FEATURES

Products listed in alphabetical order by company

	Oak Micro- Systems Ltd. Oak Micro- Systems D386/33/4	Olivetti USA Olivetti M380/XP9	PC Craft Inc. PC Craft 5000/33C	PC Max PC Max PM 386-33/M	Spear Technology Inc. Spear 386/33U	Ultra-Comp Computer Hardware Ultra-Max 386-33	Zeos International Zeos 386/33
EXPANSION BUS							
Bus speeds (MHz)	8.25,33	33	33	33	33	8.1,11,33	33
Expansion slots	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, four 16-bit, four 32-bit	One 8-bit, four 16-bit, three 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit
Slots left free after hard/floppy disk drives, video, one parallel and two serial ports are installed	5	7	4	4	4	4	5
Ports originate on motherboard	☐	☒	☒	☐	☐	☐	☐
VIDEO							
Display circuitry location	Card	Card	Card	Card	VGA	Card	Card
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Manufacturer	ATI	Olivetti	ATI	SEFCO	MaxLogic	Renaissance	ATI
Chip set manufacturer	ATI	Paradise	ATI	Trident	Paradise	Renaissance	ATI
KEYBOARD							
Manufacturer	Monterey	Olivetti	Maxi-Switch	Focus Electronic	Key Tronic	Ultra-Comp	Nan Tan
Number of keys	102	101	101	101	101	101	101
Number of function keys	12	12	12	12	12	12	12
Keyboard cable length (inches)	82	112	72	70	77.5	72	84
SOFTWARE AVAILABLE							
DOS	3.3, 4.01 (\$79)	4.01 (\$125)	3.3, 4.01 (\$75)	4.01 (\$85)	4.01 (\$68)	4.01 (\$89)	3.30 (\$98), 4.01 (\$119)
OS/2	1.1 (\$179)	1.1 (\$340)	None	Contact local dealer	1.1 (\$299)	None	1.1 (\$395)
Microsoft Windows/386	2.1 (\$199)	None	None	Contact local dealer	Contact local dealer	None	None
Disk caching software	☒	☒	☒	☒	☒	☐	☐
Expanded memory manager	☐	☒	☒	☒	☒	☐	☒
Other	Info not available	Olivetti 1.0	SCO Unix or Xenix/386	Info not available	Info not available	Disk Manager, Renaissance	Info not available
MISCELLANEOUS							
Coprocessor supported	80387	80387 or Weitek 3167	80387	Intel	80387 or Weitek 3167	80387	80387 or Weitek 1167
PHYSICAL FEATURES							
Power supply (watts)	200	265	200	230	220	220	375
Switchable settings	☒	☐	☒	☒	☒	☒	☒
Number of device connectors	5	3	5	4	5	4	5
Keyboard lock	Front	Front	Front	Front	Front	Front	Front
Case lock	None	None	Front	Front	None	None	None
Power-on switch	Front	Front	Front	Side	Front	Front	Front
Reset switch	Front	Front	Front	Front	Front	Front	Front
Hard disk options	150MB, 200MB, 380MB, 640MB 760MB (ESDI)	135MB, 304MB (ESDI)	150MB, 320MB, 765MB (ESDI)	120MB (ST-506); 144MB (ESDI)	120MB,150MB, 300MB, 380MB, 600MB (ST-506); 150MB, 160MB, 338MB, 676MB (ESDI); 150MB, 338MB, 380MB, 676MB, 766MB (SCSI)	120MB (ST-506); 100MB, 150MB, 330MB (ESDI); 150MB, 300MB (SCSI)	120MB (ST-506); 160MB, 334MB, 337MB, 674MB (ESDI)
Warranty	2 years	1 year	1 year	1 year	1 year	1 year	1 year
Service	On-site	Return to dealer	On-site	Ship to manufacturer	Ship to manufacturer or return to dealer	Ship to manufacturer; on-site optional	Ship to manufacturer; on-site optional
FCC certification	A	B	A	A	A	A	A (B pending)

☐—Editor's Choice ☒—Yes ☐—No

ENDS

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12 MHZ 286 VGA

- 80286-12 Processor
- 2 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$1995.00

GATEWAY 386SX

- 2 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$2195.00

20 MHZ 386 VGA

- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$2695.00

64K Cache Add \$500

25 MHZ 386 VGA

- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$3395.00

64K Cache Add \$500

33 MHZ 386 VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$4395.00

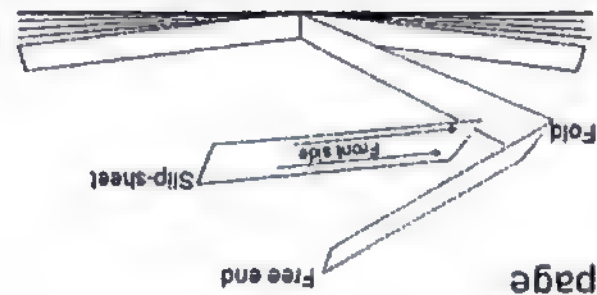
25 MHZ 486 VGA

- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

Call For Price

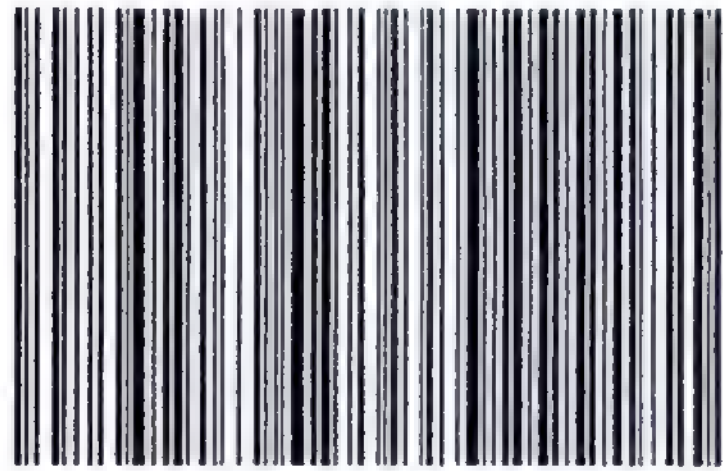
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2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

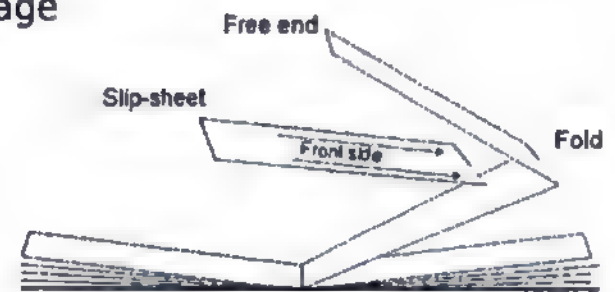


GbsSlipSheet-001



Foldout slip-sheet

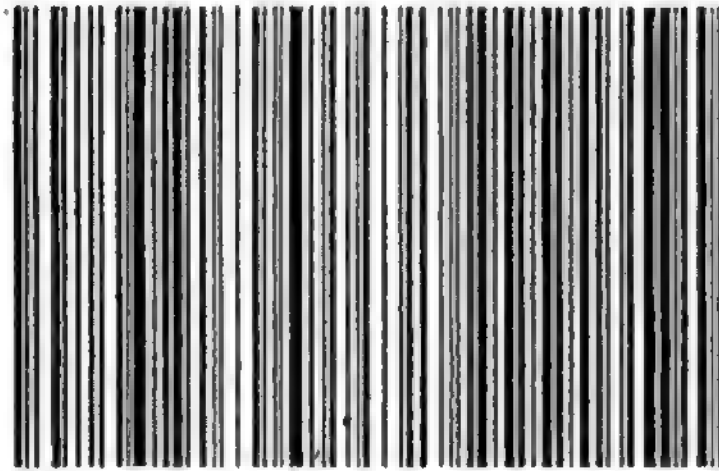
1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Folded edge of the page

1. Follow instructions on the other side

Inverted Back



GbsSlipBack-0018

Back

1. Follow instructions on the other side



Whether you are considering one computer or 1000 you can feel secure in buying from Gateway 2000. You are assured of getting fully loaded machines for the same price as the competition's stripped down models.

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Here is what the experts have to say:

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PC Magazine

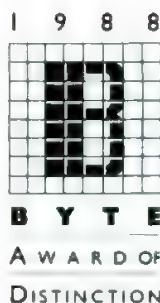
"Low-price, high quality components, solid performance, and the promise of support after the sale make the Gateway 2000 386/33 an attractive option."

PC Resource

But our commitment to excellence doesn't end with offering you exceptional machines at incredible prices. You will discover that we stand behind your decision to purchase a Gateway 2000 system in every way.

"When it comes to after-the-sale support, Gateway 2000 certainly has its heart in the right place."

PC Resource



"... when evaluating the whole package, the Gateway 386 surpasses all others."
Byte Magazine

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Here's just a small sampling of what owners of Gateway 2000 systems have to say:

"I'm convinced it would be difficult, if not impossible, to find a better, more powerful system for the price (many others agree)."
Howard A. Minnick, CMSgt, USAF
Superintendent, Communications—Computer Operations

"I like the machine. I am rather picky but no one ever lost their cool. Courteous and polite all the way. Would I do it again? You bet."
Ralph Kissel, Senior Electronics Engineer

"We've standardized on Gateway 2000 systems in our department. Your prompt service and technical support has kept our sales operation running better than ever. Based on the quality and performance of your systems, I would strongly recommend them to other corporations."

Elizabeth Coyman, Director of Inside Sales
BYTE/McGraw-Hill



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CIRCLE 364 ON READER SERVICE CARD



GATEWAY 2000'S STANDARD FEATURES

You won't have to worry about what type of diskettes your software is on. Gateway 2000 machines come standard with both a 5¼" 1.2 Meg Floppy Drive and a 3.5" 1.44 Meg Diskette Drive.

You needn't be concerned about ample disk space. Our systems come standard with high capacity/high speed hard disk drives and controllers. Including our new ESDI Cache controller capable of transferring data faster than you ever thought possible.

You won't have to pay more to run the software you want. Your system will include at least 2 Megs of Ram standard for 286 and SX systems, and 4 Megs standard for 386 systems.

You won't have to cringe when you hear our price for high resolution color graphics. All of our systems come standard with a high speed graphics combination capable of running at 1024 x 768 resolution with 16 COLORS and 800 x 600 resolution with 256 COLORS.

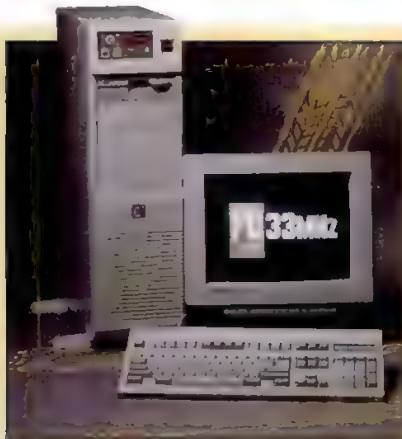
If our standard configurations don't fit your needs, don't forget that we will be happy to custom configure a system just for you.



GATEWAY2000

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inch cable. If you wish, you may substitute a Key Tronics or a Chicony keyboard and receive a \$15 credit against the system price. Considering that you're entering the 33-MHz 386 market prepared to spend at least \$5,000, the fact that C² offers this \$15 trade-in is rather charming.

Since C² systems are sold by dealers, your dealer is the first place to turn for service and support. The computer is backed by a one-year parts-and-labor warranty but no on-site service contract, although most dealers will probably work something out if you want on-site service and are willing to pay for it. In the event your dealer cannot help, C² takes technical support calls from customers and services machines directly if necessary. If you want your machine serviced by C² directly, you have to pay for shipping one way, even under warranty.

C² Microsystems has crafted an eminently expandable, strong and sturdy performer—at a price that would make even the most hardened computer shopper sit up and take notice. You should be sure to check this one out.



C² 386/33

C² Microsystems Inc., 1205 Fulton Pl., Fremont, CA 94539; (415) 683-8888.

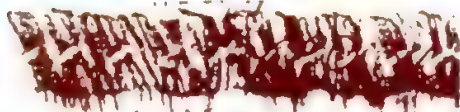
List Price: With 0K RAM, 1.2MB floppy disk drive; two serial, one parallel, and one game port, \$2,450; with 4MB RAM, 158MB hard disk, NEC MultiSync 3D monitor, video utility software, DOS 4.01, \$5,745.

In Short: The C² 386 33-MHz tower system is extremely aggressively priced and is sold only through dealers. This system has more drive bays than usual and even includes a 275-watt power supply with seven device power leads.

COVER STORY

33-MHz 386 PCs

At only \$5,745 with 4MB RAM, 158MB hard disk, and a NEC MultiSync 3D monitor, the C² 386/33 is one of the most competitively priced systems in this roundup. C² sells its machines through dealers, so look there for service as well as discounted prices.



The Club AT Model 333C performed well in testing, operating without a glitch and positioning itself among the fastest of the 33-MHz lot. The company also emphasizes Unix applications.

CLUB AMERICAN TECHNOLOGIES

Club AT Model 333C

by Mitt Jones

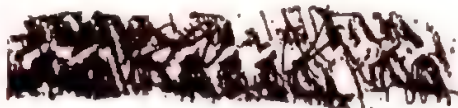
Club American Technologies' \$4,954 foray into the 33-MHz market seems at first glance to be a technological throwback. Aside from Club AT's trademark control block near the center of the front panel—a keyboard lock, reset switch, and power, turbo, and hard disk indicator lights—the chassis of this 33-MHz 386 machine is an AT clone all the way. The chassis makes room for three half-height drives that are at the right side of the system and two that are immediately to the left, behind the control panel.

But once you look inside the regression ends. The motherboard is Club AT's own design. An outfit named Parcorp claims responsibility for the BIOS. MaxLogic makes the VGA board, and National Computer Ltd. manufactures the ESDI disk controller.

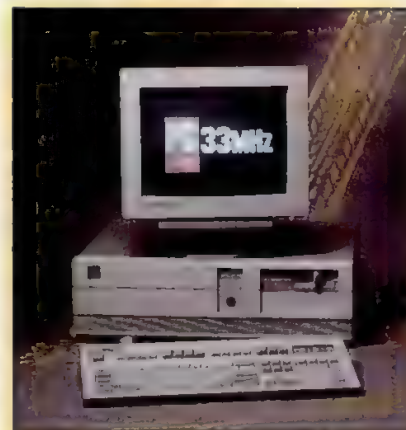
The components aren't as obscure as they may sound, however. For example: Club AT commissioned Everex to design and manufacture the 32-bit memory card. And, as it turns out, the Parcorp BIOS in the computer is simply the good ol' AMI BIOS under another name. Though it's not immediately noticeable by the component names, Club AT has done an admirable

job of obtaining quality components at a low price.

The Club AT Model 333C comes base-configured with its maximum 2MB of page-mode memory on the motherboard, supplied in our evaluation unit with 100-nanosecond DRAM in one DIP bank and 80-ns. DRAM in the other. The 32-bit memory expansion board allows you to install an additional 1, 2, 4, or 8 megabytes by filling its two banks with 256-kilobit or 1-megabit SIMMs. Our system's total memory reached 4MB.



The disk subsystem provided for evaluation coupled a National Computer Ltd. ESDI controller with a 16-millisecond 170MB Maxtor drive. The controller sports a 64K hardware cache, which should speed disk access. Unfortunately, the version sent with our evaluation unit performed little better than controllers without a cache. The company expects much higher performance with a newer



Club AT is at the head of the low-cost pack, offering its Club AT Model 333C for only \$4,954 with 4MB RAM, 105MB SCSI hard disk, VGA monitor, and DOS 3.31. Not just a bare-bones system, Club AT includes solid documentation in addition to LAN and Unix support, adding up to a great value.

version by the time this issue hits the newsstands. Our evaluation unit came complete with a 33-MHz Intel 80387 math coprocessor; the socket can also accept a Weitek 3167.

Other equipment included a TEAC 1.2MB 5.25-inch floppy disk drive, an Everex I/O card, and a NEC MultiSync 3D monitor. Standard software includes the familiar AMI ROM-based setup routine and Storage Dimensions' SpeedStor, which features the Speed Cache disk cache program.

Club AT offers high-resolution graphics options for those interested in a budget-priced CAD workstation, including a \$3,944 subsystem that features a NEC TI-based high-resolution adapter and 20-inch high-resolution monitor. The subsystem

Compared with much of its low- and mid-priced competition, however, the Club AT Model 333C is an excellent choice, not only for its price but for its performance, competent design, and sturdy construction.

CSS LABORATORIES INC.

CSS MaxSys

by Bill O'Brien

CSS Laboratories' MaxSys arrived in one of the few towers not painted that mellow shade of beige that seems to be de rigueur for computers these days. Its primer-gray enclosure was home for a single half-height 5.25-inch 1.2MB floppy disk drive, and an equally diminutive hard disk drive.

The black faceplates on the drives and three empty half-height bays, as well as the black status panel, actually made this \$6,420 machine pleasant to look at. But if nothing else, the MaxSys disproves two important axioms: "Looks aren't everything" and "You get what you pay for."

CSS lays claim to the motherboard powering this machine and adds an AMI BIOS for authority. There is no single 80386 chip set in this machine. Instead, everything is done with discrete logic. Add

the overzealous 20-nanosecond RAM cache under an Intel cache controller, and according to the PC Labs benchmark tests, CSS has done a good construction job. Both the Instruction Mix and Conventional Memory numbers place it firmly in the top 20 percent of the machines tested.

But it's a good thing that the cache is so effective. The conventional-memory chips are rated at 100 ns. and, according to CSS, are running at three wait states to compensate for their lackluster rating in an environment in which they would be otherwise totally inappropriate.

Mated to an Adaptec controller, the 94MB Imprimis ESDI hard disk carried on with almost reckless abandon, careening through the suite of disk tests and finishing among the top group of computers with



FACT FILE

Club AT Model 333C

Club American Technologies, 3401 W. Warren Ave., Fremont, CA 94539; (415) 490-2201.

List Price: With 2MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, utilities, ROM-based setup software, \$2,895; with 4MB RAM, 105MB SCSI hard disk, VGA monitor, DOS 3.31, \$4,954; with 170MB ESDI hard disk, 80387/33 coprocessor, NEC MultiSync 3D monitor, \$6,046.

In Short: The Club AT Model 333C combines field-leading performance, solid construction, and knowledgeable technical support at an exceptionally low price. Available via direct order only in either the desktop model, as reviewed, or in a tower configuration.

CIRCLE 399 ON READER SERVICE CARD



FACT FILE

CSS MaxSys

CSS Laboratories Inc., 1641 McGaw Ave., Irvine, CA 92714; (714) 852-8161.

List Price: With 2MB RAM, 1.2MB floppy disk drive, \$3,450; with 4MB RAM, 106MB ESDI hard disk, NEC MultiSync 3D monitor, 80387 coprocessor, \$6,420.

In Short: The CSS MaxSys is a solid machine with excellent mid- to high-range performance characteristics in all but text handling. As a file server, CSS is negotiating the availability of a 1.2GB drive that should provide ample storage space for any serious network use.

CIRCLE 400 ON READER SERVICE CARD

provides a noninterlaced resolution of 1,024 by 768 in 256 simultaneously displayed colors.

Club AT prides itself on being an authorized Novell reseller, making the tower model a good choice for LAN server applications. Club AT also stresses dedication to Xenix/Unix applications and sells and supports the Everex version of Xenix. Club AT technical support is free, though the call isn't. The company reports a 24-hour turnaround on returned parts. On-site service through NCS is available at an additional charge.

The Club AT Model 333C performed well in testing, operating without a glitch and positioning itself among the fastest of the 33-MHz lot.

Does the 333C compete with the big boys? Of course not. The 333C lacks the attention to detail and the rock-solid quality you'd find in a Compaq or an IBM.



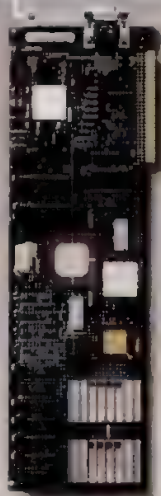
Inside the attractive basic gray tower case of the CSS MaxSys are five drive bays and eight free expansion slots to go with the 4MB RAM, a 106MB ESDI hard disk, and a NEC MultiSync 3D monitor; DOS is optional. The whole system lists for \$6,420.

noncaching controllers. Its DOS File Access (Large Record) test numbers suffered slightly, but the combination of large- and small-record test results makes it quite impressive over the full range of data-handling hurdles. Three 8-bit, seven 16-bit, and two 32-bit expansion slots round out the motherboard.

The MaxSys video results are a letdown and quite puzzling. Because this machine was equipped with a Video Seven V-RAM 16-bit adapter, the horrendous times seem out of place. Granted, the video BIOS was not shadowed during the test, but such was the case for all of the reviewed machines. Bus speed on the MaxSys is a software-friendly 8 MHz, so even that offers no clear clue to the problem.

Apparently CSS has found some semi-magical combination of medium technology that will yield sterling performance in all but text-based applications, and it has done so at a reasonable price. CSS is even willing to give you an enclosure that you won't want to hide under your desk.

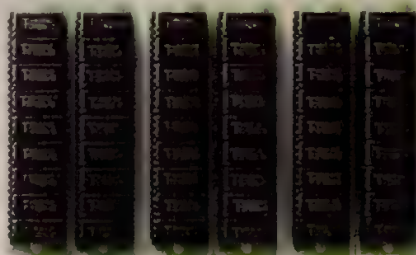
The expandability of our 386SX lets you carry a lot of clout.



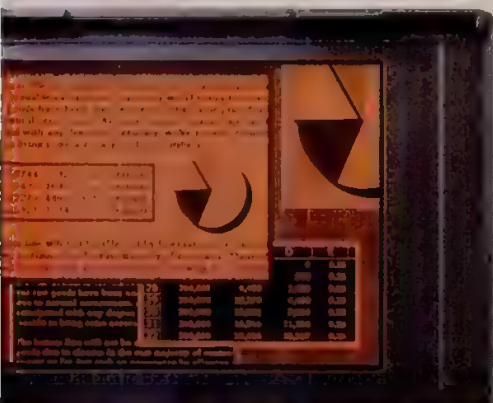
Networking Clout. Two IBM-compatible expansion slots, one full-length and one half-length slot, let you connect to LANs, mainframes and more.



Desktop Clout. A 91-key keyboard (101-key keyboard compatible) comes complete with separate cursor control and numeric keypad, making the T3200SX a true desktop replacement. Plus, a built-in port lets you attach a 101-key enhanced keyboard.



Memory Clout. Three dedicated internal expansion slots let you increase memory up to 13MB as your need for power grows.



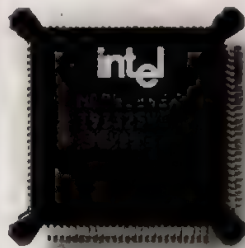
Graphics Clout. For exciting business presentations, the T3200SX's VGA graphics system can be teamed up with a color VGA monitor for simultaneous dual-screen viewing.



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CIRCLE 162 ON READER SERVICE CARD

DATAWORLD

Dataworld Data 386-33

by Bill O'Brien

Don't let the picture of the Dataworld Data 386-33 fool you. The machine looks like just another computer packed in a tower enclosure, and, on the face of things, neither the 5.25- nor the 3.5-inch high-density floppy disk drives will give you any clue as to what's inside this \$8,980 tribute to the wonders of excess. If that price startles you, take a long, deep breath and look inside.

At first you'll think that the Data 386-33 uses a backplane because you'll see a massive I/O card with enough RAM on-board to satisfy most computers. It's not the case at all. Dataworld has stuffed this machine with a PSI disk controller card containing 4MB of fast 80-nanosecond RAM. The PSI card is so sophisticated that it not only has its own BIOS, as do all disk controllers, but it also needs to be configured for the drive you're using. The configuration is done through externally loaded software included with the system. Disk parameters are saved in nonvolatile RAM on the PSI board.

Mated to this monster controller in the test machine was a 300MB Siemens ESDI hard drive. Our review system came with DOS 3.3 installed—a shame if you prefer a single large volume rather than an alphabet of logical drives. DOS 4.0x is available as an option.

The net effect of these two disk heavyweights is that the Data 386-33 has an outstanding data throughput system. Small-record benchmark test numbers are quite low, as you'd expect with a caching controller. But large-record numbers also receive a dose of hyperspeed thanks to the incredibly large amount of cache RAM installed on the card. The real-world result will be blazing record handling from within a data file as well as unstoppably fast program loads.

Even better, Dataworld hasn't included the PSI card as a hinge on which to hang an otherwise lackluster system. Aside from its expansion strengths—six half-height drive bays; two 8-bit, six 16-bit, and one 32-bit expansion slots—the Data 386-33 shows its computing strengths throughout the benchmark test results. With regard to the three processing tests, it ranks dead

COVER STORY 33-MHz 386 PCs



At \$8,980, Dataworld's Data 386-33 might seem expensive, but with a 320MB ESDI hard disk, a 4MB PSI caching disk controller, and NEC's MultiSync 4D, this PC is ready for any power user. Offering a wide variety of configurations, the Data 386-33 is one of the best 33-MHz 386 values currently available.

center in the middle of the pack, thanks to the 80-ns. system RAM backed by ultra-quick 25-ns. processor caching RAM. A midrange rating is eminently respectable, considering the small time margin separating first from last.

Even the video times governing text-handling operations, where computers are most susceptible to foot dragging, are exceptional if you grant a small bit of interpretation. While the Orchid ProDesigner VGA hardware yielded decidedly middle-of-the-road performance on the Direct-to-Screen test, addressing the video through its BIOS is another story entirely. The results of these two benchmark tests, using an access method that's preferred but often

ignored by software programmers, rushes the Data 386-33 up to the top third of the pack. The optional PixelPro video card is generally faster throughout.

If CPU and disk performance don't impress you, you can look to the keyboard and video display, where you and the computer meet on equal footing. The Data 386-33 comes with a serviceable Focus Electronic keyboard whose key resistance is such that you'll never mistake it for a tray of jello. The NEC 4D video monitor provides crisp text and vivid colors, as a quality display should.

For those looking for the strongest combination of raw computing and storage ability—as well as down-the-road flexibility—Dataworld's attention to both electronic and human engineering positions this 33-MHz beauty as a viable contender for even the most fussy power user.

DESTINY COMPUTERS

Destiny 386-33

by Mitt Jones

One of the pleasures of mail-order houses is that some let you choose from a few brand names for each major component. Knowledgeable buyers can have a field day. Apply that concept to a dealer, and you've got a good idea of what separates the Destiny line of computers from the crowd.

The approach does have its disadvantages, though. For instance, if you need documentation that leads you through installation of the system, or much documentation at all, this isn't the computer for you. If our feature-packed, \$8,665 test unit is any indication, however, those who want the comfort of dealer support and the flexibility of a mail-order house may do well with the Destiny 386-33.

One of the most appealing aspects of our test unit was its hefty tower chassis, a \$695 option. Measuring 24.5 by 9 by 23 inches (HWD), the case stacks its generous allotment of ten half-height bays behind the front panel, which can allow front access to as many as six of the drives. Swing open the hinged front panel, which leaves a cutout for the power switch and indicator lights, and you see all ten bays plus the reset and keyboard-lock switches. Loosen five screws and you can open the hinged side panel, allowing access to the remainder of the machine.

FACT FILE

Dataworld Data 386-33

Dataworld, 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660-1404; (800) 776-DATA.

List Price: With 1MB RAM, 1.2MB or 1.44MB floppy disk drive, 12-inch amber monochrome monitor, one parallel port, \$3,198; with 4MB RAM, 320MB ESDI hard disk, VGA monitor, \$5,767; with 1.2MB and 1.44MB floppy disk drives, 4MB PSI caching disk controller, NEC MultiSync 4D monitor, \$8,980.

In Short: The Dataworld Data 386-33 is a major player in the 33-MHz marketplace, with high-speed components and expandability giving it consistently high marks.

CIRCLE 401 ON READER SERVICE CARD

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At only 13.4 inches wide and 14.2 inches deep, microLaser may be the small kid on the block, but it packs plenty of punch. This printer takes full advantage of the advanced software that runs on your PC. That's because it uses the Adobe® PostScript printer language and is compatible with the HP LaserJet® Series II — allowing you to switch between them easily. With that kind of flexibility, the six-page-

PostScript language, you can print fonts in a variety of type styles and sizes. Plus, you can print them tall-ways, long-ways, all kinds of ways. You can even print complex pages of integrated text and graphics.

Capabilities that grow as your needs grow.

One of the best things about microLaser is that you only buy what you need. So if you're not ready for PostScript language, you can buy the standard microLaser for less than \$2,000 and add PostScript software and other powerful features later.

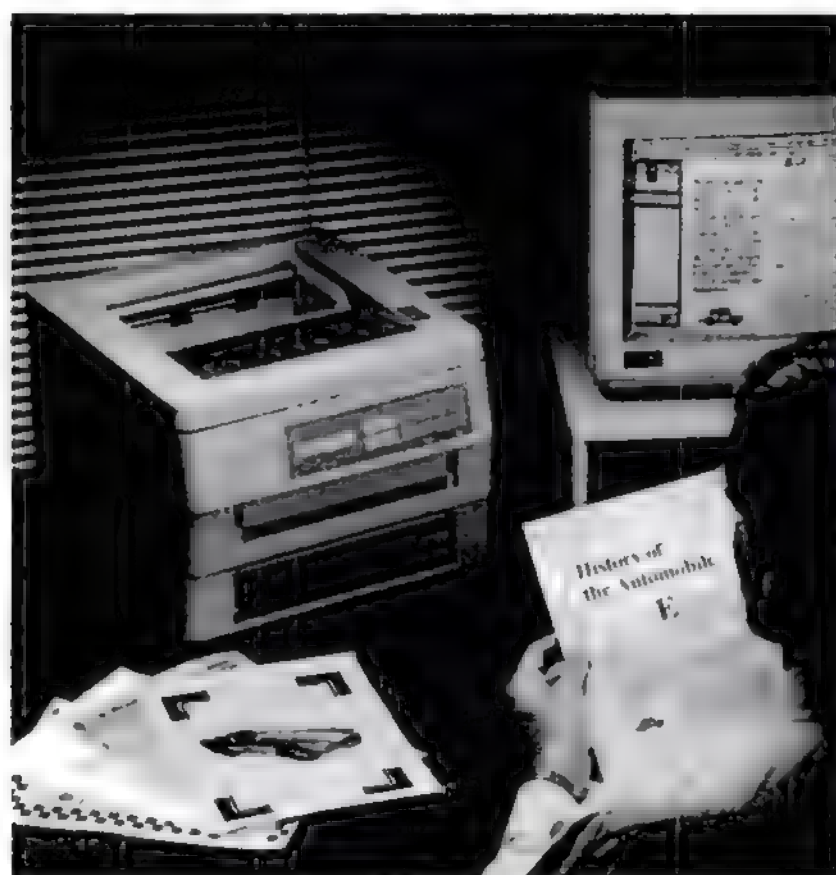
You can upgrade microLaser without tools or technicians by simply adding upgrade boards. These boards include up to four 1 Mb increments of memory, serial and AppleTalk® interfaces and a PostScript interpreter. All you have to do to get additional fonts or emulations is plug optional microCartridges into two credit card-size slots.

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Part of what makes microLaser a truly personal, desktop laser printer that takes up so little room is its paper drawer, which slides inside. Because microLaser holds 250 sheets standard (it holds 500 when you add an optional paper drawer), you spend less time refilling paper and more time creating superb-

looking documents.

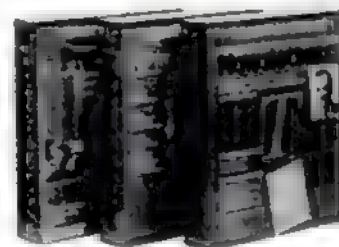
The printer also handles a variety of paper sizes and types — from letter, legal and executive to transparencies, labels and



per-minute microLaser is ideal for word processing, spreadsheet and desktop publishing applications.

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CIRCLE 736 ON READER SERVICE CARD



BENCHMARK TESTS: 33-MHz 386-BASED PCs

HIMS Technology's Cache Pro 386/33 reigns as the fastest production machine to pass through PC Labs. As the performance margin separating these machines continues to shrink,

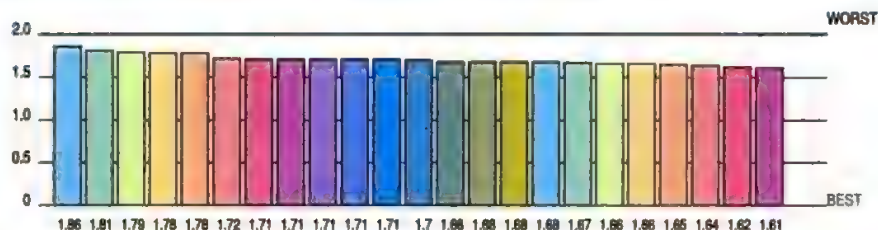
the HIMS Cache Pro uses the brute force of a 256K write-back cache to edge past the Eltech Model 9970 on the 80386 Instruction Mix and Floating-Point benchmark tests.

PROCESSOR AND MEMORY BENCHMARK TESTS

80386 Instruction Mix

Elapsed Time (seconds)

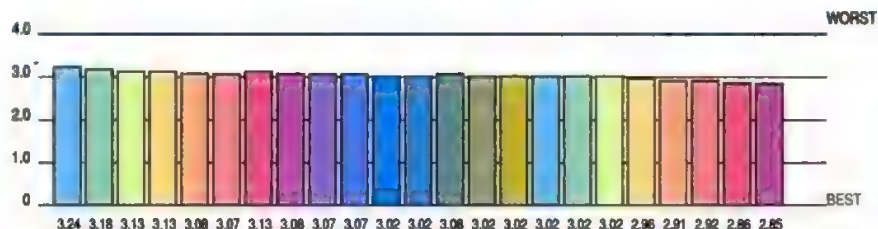
The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



Floating-Point Calculation Without Coprocessor

Elapsed Time (seconds)

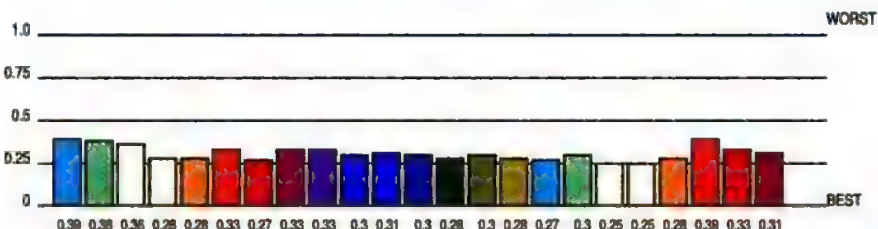
The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

Elapsed Time (seconds)

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of RAM memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

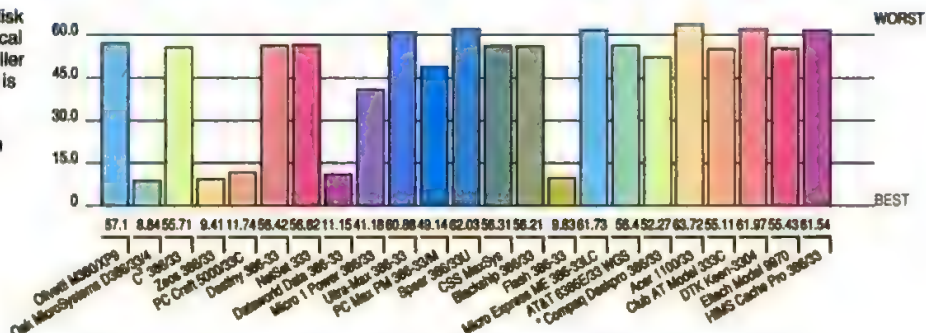


DISK BENCHMARK TESTS

DOS File Access (Small Records)

Elapsed Time (seconds)

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



All units were tested with processor cache enabled. BIOS shadowing was disabled except in the cases of the Olivetti M386/33, the Zeos 386/33, and the NetSet 333, which do not permit system BIOS to be disabled.

* Reported for comparison.

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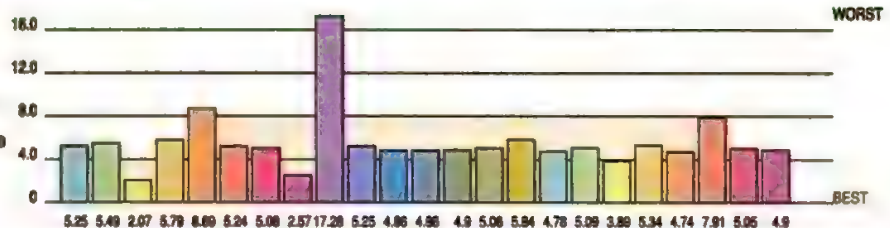


BENCHMARK TESTS: 33-MHz 386-BASED PCs

DOS File Access (Large Records)

Elapsed Time (seconds)

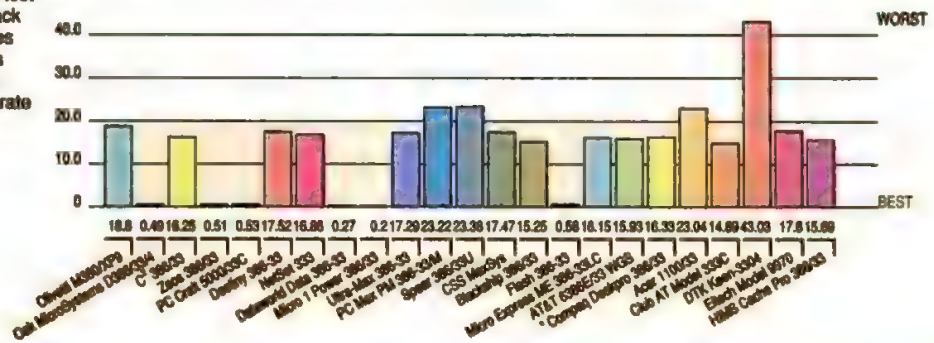
The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

Elapsed Time (milliseconds)

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



* Reported for comparison.

CONTINUES

As a rather odd touch, the expansion slot brackets open along the top of the machine instead of the back, but a removable roof of sorts conceals the brackets and leaves room for the cables to exit from the rear.

Inside the machine, you'll find a nice collection of quality components. The Micronics motherboard, Phoenix BIOS, and an Intel 82385-governed static RAM cache, which came half filled with 32K, provide the base electronics. Micronics relegates all page-mode system RAM to its proprietary, 32-bit adapter, which accommodates up to 8MB with existing DIP sockets and up to 16MB with the help of a daughtercard. The math coprocessor socket, empty in our unit, accepts either the Intel 80387 or Weitek 3167.

FACT FILE
Destiny 386-33

Destiny Computers, 754 Whitney St., San Leandro, CA 94577; (800) 366-4272.

List Price: With 1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, QA Plus diagnostics, Micronics setup program, and MICEMM extended memory manager, \$3,400; with 4MB RAM, 150MB hard disk, VGA monitor, DOS 3.31, \$6,595; with tower chassis, 19-inch VGA monitor, \$8,665.

In Short: A dealer-distributed machine that offers a wide range of standard components in either a desktop or tower model. Not a star, but a respectable computer in both construction and performance.

CIRCLE 402 ON READER SERVICE CARD

Our evaluation unit came with an authentic Western Digital WD1007-WA2 disk controller, which is capable of supporting as many as two ESDI hard drives and two floppy disk drives. The ESDI hard disk was an 18-millisecond MiniScribe 3180E that had a formatted capacity of 157MB.



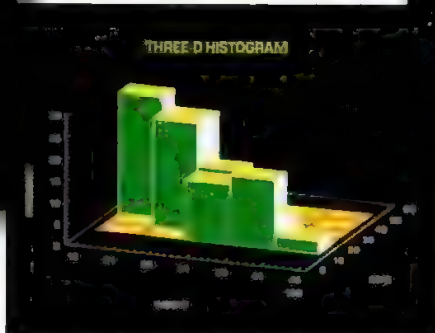
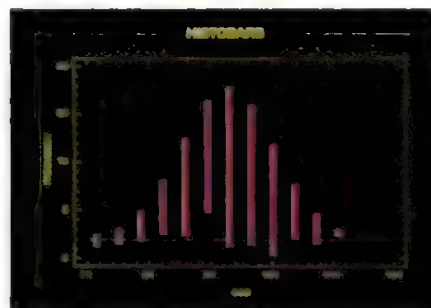
Although light on documentation, the \$6,595 Destiny 386-33 combines the configuration flexibility of a mail-order company with the hand-holding support of a dealer. Destiny will build to order exactly the 33-MHz 386 system you need in either a desktop or a tower model.

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CIRCLE 365 ON READER SERVICE CARD

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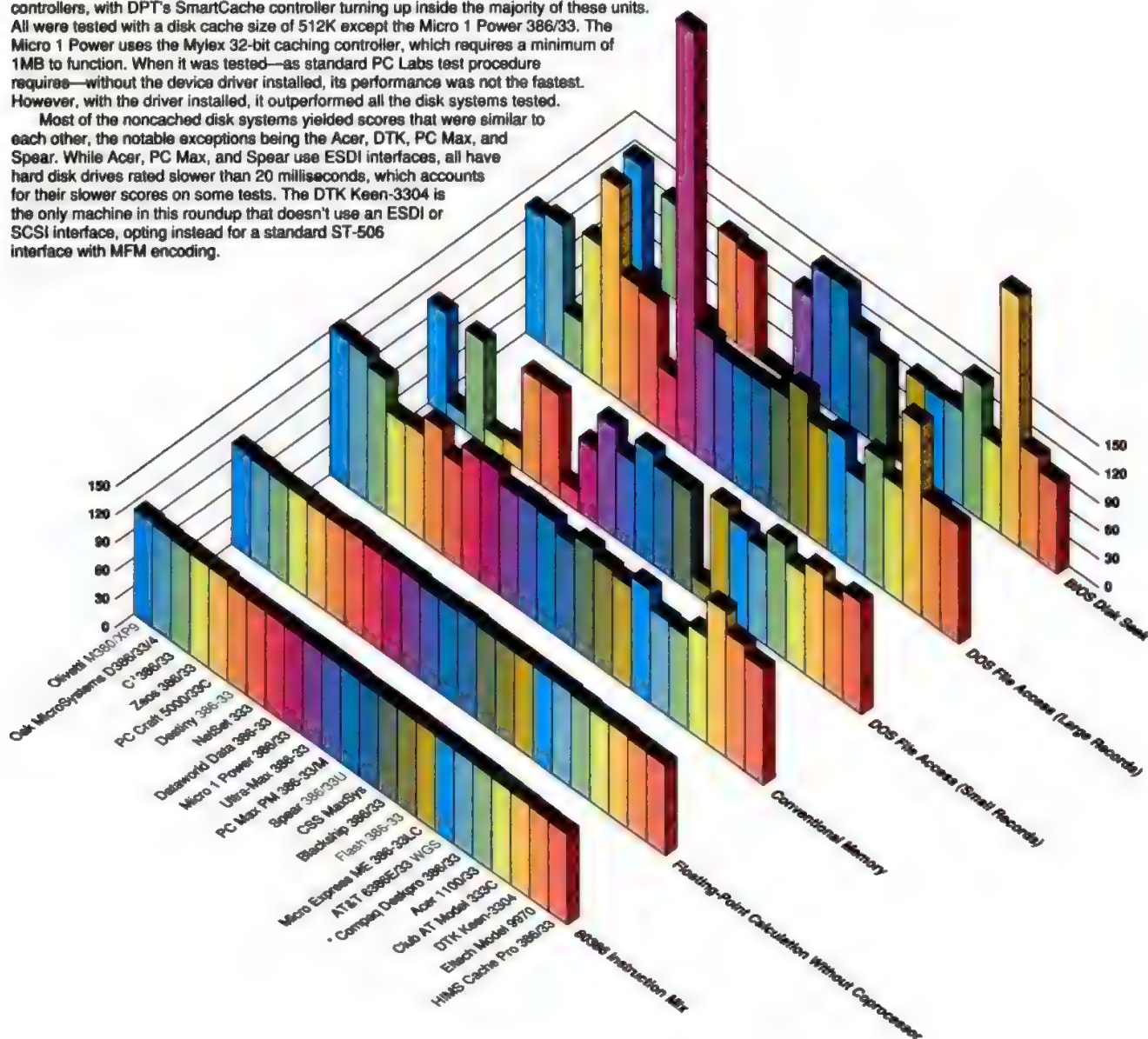
PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

Not much is new on the performance front for 33-MHz 386 computers since the last time we looked at them (*PC Magazine*, October 31, 1989). The new speed king is the HIMS Cache Pro 386/33. With 256K of write-back cache installed in its proprietary motherboard, the Cache Pro is the fastest machine ever to go through PC Labs' 80386 Instruction Mix and Floating-Point tests. That's not to say that the other machines reviewed here aren't fast: the Elitech, DTK, Club AT, and Acer machines matched or bested the Compaq Deskpro 386/33—our comparison machine and Editor's Choice for the previous roundup, together with the Northgate Elegance 386/33. One machine lagged behind the rest of the field: the Olivetti M380/XP9. Its lackluster (for a 33-MHz machine) performance is due to the combination of its small processor RAM cache size (32K) and a lack of interleaving, or page-mode memory, that would speed system RAM accesses on cache misses.

Disk performance for many of these machines was aided by hardware caching controllers, with DPT's SmartCache controller turning up inside the majority of these units. All were tested with a disk cache size of 512K except the Micro 1 Power 386/33. The Micro 1 Power uses the Mylex 32-bit caching controller, which requires a minimum of 1MB to function. When it was tested—as standard PC Labs test procedure requires—without the device driver installed, its performance was not the fastest. However, with the driver installed, it outperformed all the disk systems tested.

Most of the noncached disk systems yielded scores that were similar to each other, the notable exceptions being the Acer, DTK, PC Max, and Spear. While Acer, PC Max, and Spear use ESDI interfaces, all have hard disk drives rated slower than 20 milliseconds, which accounts for their slower scores on some tests. The DTK Keen-3304 is the only machine in this roundup that doesn't use an ESDI or SCSI interface, opting instead for a standard ST-506 interface with MFM encoding.

Relative Times
(Compaq Deskpro 386/33 = 100)



* Reported for comparison.

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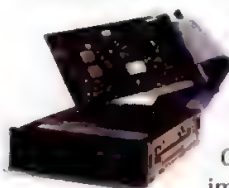
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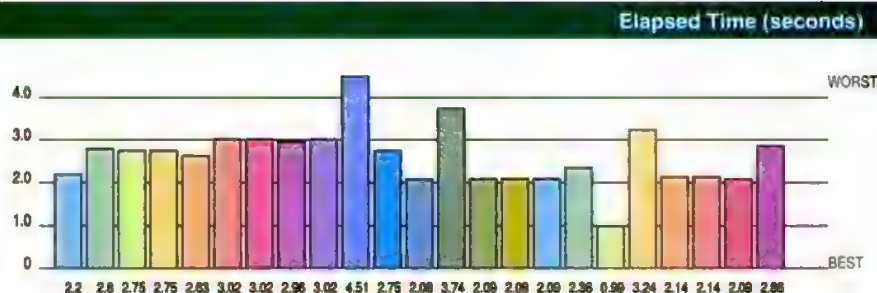


BENCHMARK TESTS: 33-MHz 386-BASED PCs

VIDEO BENCHMARK TESTS

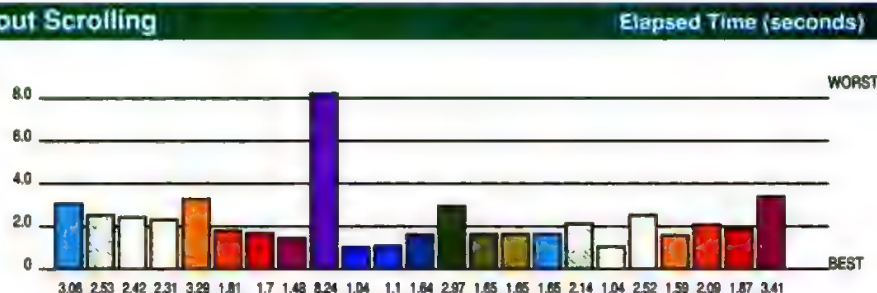
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



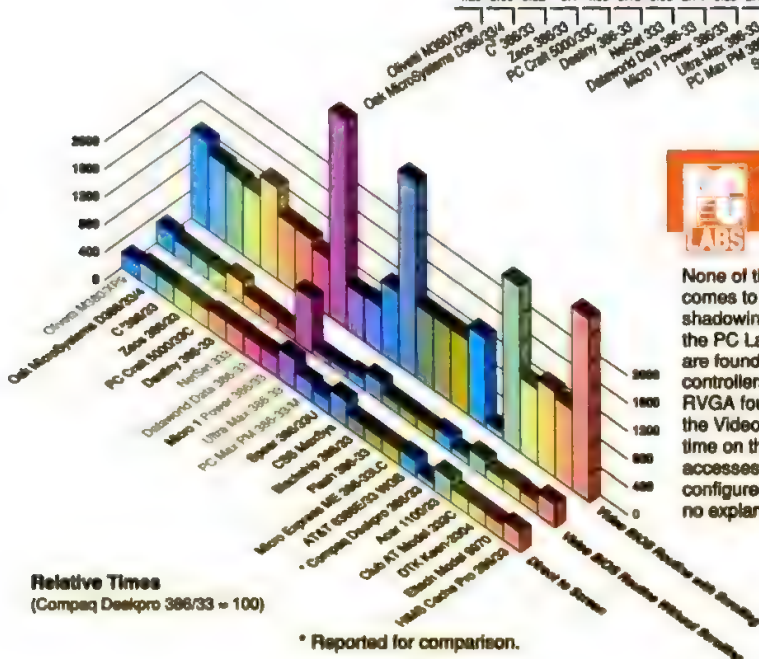
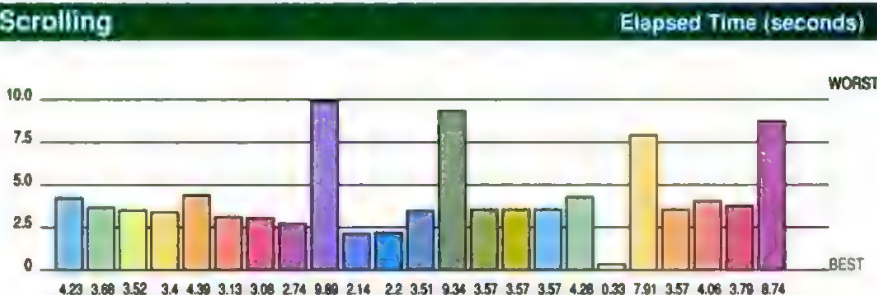
Video BIOS Routine Without Scrolling

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



Video BIOS Routine with Scrolling

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



VIDEO BENCHMARK TESTS: COMPOSITE VIEW

None of these machines compare to the Compaq Deskpro 386/33 when it comes to video performance. Its integrated video controller and video BIOS shadowing—which cannot be disabled—make the Compaq scream through the PC Labs video benchmark tests. A variety of different display controllers are found in the top-performing machines in this category, including controllers from Orchid, Maxlogic, and Sefco. Strangely, the Renaissance RVGA found in the Ultra-Max 386/33 turned in some of the fastest times on the Video BIOS Routines both with and without scrolling, but the slowest time on the Direct to Screen test. This performance indicates that the system accesses video memory only 8 bits at a time, despite the board's being configured for 16-bit video memory operation. A company spokesperson had no explanation for this phenomenon.

ENDS

COVER STORY

33-MHz 386 PCs

The VGA subsystem supplied with the test unit was somewhat of a surprise, not because of the Orchid ProDesigner VGA adapter but because of the 19-inch Casper VGA monitor, capable of 800 by 600 non-interlaced resolution. Of course, 19-inch monitors come at a premium, and Destiny provides plenty of alternatives.

The bottom line? The Destiny 386-33 seems well built, performs within the range you'd expect for a 33-MHz machine, and carries an attractive, if not spectacular, price. Add the one-year parts-and-labor warranty (supplied through your closest Destiny dealer) and the company's willingness to configure the machine the way you want it, and the Destiny Computers system begins to look attractive enough to make the final cut.

DTK COMPUTER INC.

DTK Keen-3304

by Henry Fersko-Weiss

One of the first things you notice about DTK Computer's Keen-3304 is its size: it is especially compact for a tower case machine. The 21- by 7- by 17-inch (HWD) case makes it about four inches shorter than the typical tower and a bit slimmer, as well. It looks more like a desktop computer turned on its side.



Sporting a slim, undersize tower design, the DTK Keen-3304 is a well-constructed, almost silent 33-MHz 386. At \$7,499, which includes a Maxtor 160MB hard disk that could use a speed boost and DTK's own high-performance system board, the Keen-3304 is a durable personal computer at a fair price.

Despite its diminutive size, the Keen-3304 boasts a standard complement of eight slots, five I/O port cutouts, and five half-height drive bays. While its processor performance is among the highest in our review group, its price falls only in the middle range. A standard configuration, including 4MB of RAM, a 64K RAM cache, 120MB hard disk, a 1.2MB 5.25-inch floppy disk drive, VGA monitor, and DOS 4.0, costs \$7,399.

The case of the computer is quite strong—important for a machine that lives on the floor and is likely to get kicked or banged at some point. Because of its solid case, the Keen-3304 is very quiet. When it's sitting on the floor, you can hardly tell it's on.

Once you have the cover off, you can see that its compact size leaves little extra room inside. Still, you can get to the backs of the drives, the slots, and important areas of the motherboard without tearing up your fingers.

The motherboard is DTK's own, populated with discrete logic integrated PAL chips, which cut down the total number of chips, making for less operating heat and therefore greater long-term reliability.

In the machine we tested there were 4MB of RAM, but up to 8MB can reside on the motherboard. The memory uses a direct-mapped cache system that results in zero-wait-state operation. The 64K of RAM cache can be upgraded to 256K.

Unfortunately, the Keen-3304 scored the worst time on our conventional memory test. It was, in fact, 56 percent slower than the best result on this test.

The Keen-3304 also didn't fare well on the disk benchmark tests. The computer we tested had a 160MB Maxtor hard disk using MFM encoding. It has an average seek time of 26 milliseconds, which may account for its bad showing.

These poor results are counterbalanced by the excellent results on the processor tests. The computer came in third and fourth respectively on the Instruction Mix and Floating-Point Calculation tests. And its scores were only 2 percent slower than the best results on both tests.

The excellent processor performance and expansion capability of the Keen-3304 make it a very good network file server, though it would require faster hard disk subsystems to handle heavy file-access traffic. DTK offers many add-in options to outfit the computer for network use. For



FACT FILE

DTK Keen-3304

DTK Computer Inc., 15711 East Valley Blvd., Industry, CA 91744; (818) 333-7533.

List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, DOS 4.01, \$3,299; with 4MB RAM, 120MB hard disk, VGA monitor, \$7,399; with 160MB hard disk, \$7,499.

In Short: The processor in the DTK Keen-3304 tested very close to the top, but the 3304's other test results were poor to middling. Although the tower case is more compact and slimmer than the average, the computer still has a very good expansion profile. This computer is a mixed blessing.

CIRCLE 407 ON READER SERVICE CARD

example, you can put in a 650MB hard disk and a 500MB internal tape drive.

As a small-footprint tower machine, the DTK might fit into your 33-MHz future, but its lackluster general performance might make you willing to make more space for a better performer at less cost.

ELTECH RESEARCH INC.

Eltech Model 9970

by M. David Stone

The Model 9970, from Eltech Research, may not have much of a name, but whatever the name lacks in pizzazz, the system makes up for in performance. In particular, its scores on PC Labs' processor tests are among the fastest for any of the 33-MHz systems tested, and at a price of \$6,535 as reviewed, the Model 9970 breaks from the gate in intriguing fashion.

Our review unit arrived in a desktop chassis measuring 6.5 by 21.5 by 16 inches (HWD). A tower chassis is also available for \$150. The desktop chassis has the typical five half-height bays. Three bays were taken up with a 148MB Imprimis hard disk and a TEAC 5.25-inch 1.2MB floppy disk drive, leaving two half-height bays available. Also included was a Nanao Flexscan 8060S monitor and a Mitsumi Electric Co. keyboard.

Inside the box resides the Eltech Research motherboard with AMI BIOS, a 64K to 256K cache memory, and eight SIMM sockets for 8MB of RAM. An additional 8MB can be installed on an optional 32-bit memory board, for a system maximum of 16MB. The review system had the 256K maximum 20-nanosecond RAM processor cache and 4MB of 80-ns. RAM.

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PC LABS BENCHMARK SERIES R

	Instruction Mix	Floating Point Calculation
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IBM PS/2 Model 50Z	5.68	11.21
Compaq Deskpro 386S	4.48	9.67

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Date of Residence _____ Month Year _____ Monthly Payment \$ _____ ☐ Buy ☐ Rent ☐ Other

Previous Address _____

Dates of Residence _____ From _____ To _____

Your Employer _____ (If self-employed, see rear panel.)

Date of Employment _____ Mo. Yr. _____ Position _____

Monthly Income _____ Gross \$ _____ Net \$ _____

Employer's Address _____ Street _____

City _____ State _____ Zip _____ Business Phone _____ ()

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Relationship _____

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Include joint information, if joint account requested

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☐ VISA ☐ Mastercard Payment _____ Balance _____

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☐ **Individual Credit** Complete sections "a" and "b" only.

Please complete all appropriate sections, *providing at least two years' residence and employment history*. This will enable your information to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" below.

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Payment _____ Balance _____

Other Credit References _____ Payment _____ Balance _____

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c. Joint Personal Information

Joint Name _____ First _____ Initial _____ Last _____

Date of Birth _____ Mo. Day Yr. Social Security Number _____

Address _____ Street _____ Apt. # _____

City _____ State _____ Zip _____

Date of Residence _____ Mo. Yr. Home Phone () _____

Employer _____

Date of Employment _____ Mo. Yr. Position _____

Monthly Income _____ Gross \$ _____ Net \$ _____

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City _____ State _____ Zip _____ Business Phone _____ ()

d. Self-Employed Information

Complete this section only if you are self employed.

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() Telephone _____

3. Financial statement on business attached.

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FACT FILE

Eltech Model 9970

Eltech Research Inc., 1725 McCandless Dr., Milpitas, CA 95035; (408) 942-0990.

List Price: With 1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, *QA Plus* advanced diagnostics, Phoenix Control 386 EMM and Disk Caching software, DOS 3.3 or 4.01, \$3,095; with 4MB RAM, 150MB hard disk, VGA monitor, \$5,485; with VGA multiscanning monitor, 80387/33, \$6,535.

In Short: Available in either a desktop or tower chassis, the Eltech Model 9970 offers a credible combination of price and performance. Distribution is direct from Eltech only but is backed up by a one-year on-site parts-and-labor warranty.

CIRCLE 403 ON READER SERVICE CARD

The Eltech board sports eight slots: one 8-bit, six 16-bit, and one proprietary 32-bit slot. In the review system, three of these were filled with a Paradise VGA Plus 16 board, a Western Digital disk controller card, and an Eltech serial/parallel card with one serial and one parallel port.

Yet another card slot was taken up by a game port and second serial port connected to the serial/parallel card. According to Eltech, the same connectors can be disconnected from the slot bracket and repositioned to use the additional I/O cutouts on the back of the chassis rather than using a system slot cutout.

In all three processor tests, the 9970's times differ from the fastest times measured by a narrow margin. Performance on the disk tests and video tests was less impressive, but generally midrange or better.



The \$6,535 Model 9970 from Eltech Research comes in a too-pliable case, but its processor benchmark scores are strong. With 256K of 20-nanosecond cache memory, the 9970 is one of the fastest machines tested in PC Labs.

DEMONSTRATION 33-MHz 386 PCs

And, of course, you can always get better disk performance by choosing a faster disk drive, using the disk-caching software that comes with the unit, or opting for the DPT disk controller with on-board cache capabilities rather than the Western Digital controller.

One possible issue is the chassis, which is so flexible that you can easily bend it out of shape. This much pliability simply doesn't give solid enough support for the motherboard. If you move this system around, you should reseal the boards before starting it up again.

The review system did not come with a shadow RAM feature. But according to Eltech, the production unit ships with shadowing software as well as *QA Plus* advanced diagnostics from DiagSoft, disk caching software, and your choice of DOS 3.3 or 4.01. A final noteworthy feature is the one-year warranty for parts and labor, complete with on-site service. The availability of on-site service is particularly important since the system is available only directly from the manufacturer.

While the Eltech Model 9970 offers a solid combination of price, performance, and system support, it hardly offers numbers that merit purchasing it over machines that perform better for over a grand less.

FORTRON/SOURCE

NetSet 333

by Lori Grunin

The components of Fortron/Source's tower NetSet 333 indicate that the machine was built for network speed: 70-nanosecond DIP RAM for the main memory, 15-ns. DIP RAM in the 64K cache, and a sub-18-millisecond MiniScribe ESDI hard disk drive. And to top it off, this potential speed demon—configured with 4MB of memory, VGA video subsystem, and a 150MB disk drive—costs only \$5,900.

The NetSet uses a Fortron-modified AMI motherboard; Fortron says the modifications offer speed improvements over a plain-vanilla board. But although the board functioned normally, the modifications looked messy: additional chips were poorly inserted, with pins crumpled or sticking out of the sockets.

Despite the sleek look, fast components, and motherboard alterations, our



The Fortron NetSet 333 is definitely built for speed. Featuring 8MB of RAM and a 150MB MiniScribe hard disk, this \$5,900 tower wasn't as speedy as expected, but with one full-height and four half-height drive bays, as well as the optional 1K-resolution video, this tower would make a good choice for CAD and power graphics users.

benchmark test results didn't indicate any speed advantage over the other machines in this survey; the bus runs at only 8 MHz, ensuring compatibility with most add-on boards, but slowing the machine to four wait states.

On-board memory consisted of 4MB of 1-megabit DIPs, expandable to a maximum of 8MB with an additional 4MB of SIMMs. A 32-bit slot that doubles as an 8-bit slot can hold another 16MB on an optional memory card. The motherboard has the usual eight slots, but the way Fortron configured its machine wasted a slot: instead of using two of the eight cutouts for the serial ports, these ports were mounted on a bracket, rendering one of the 16-bit slots inaccessible. Not a major disaster, but a potential user nuisance. The motherboard also accepts a Weitek 3167 or an 80387 coprocessor.



FACT FILE

NetSet 333

Fortron/Source, 6818-G Patterson Pass Rd., Livermore, CA 94550; (415) 373-1008.

List Price: With 1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3, \$3,190; with 4MB RAM, 150MB hard disk, VGA monitor, \$5,250; with 8MB RAM, 1.2MB and 1.44MB floppy disk drives, \$5,900.

In Short: A tower system composed of quality parts that has file server or CAD workstation potential.

CIRCLE 404 ON READER SERVICE CARD

PC
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SUPERCALC5



In our test configuration, the other slots held a 16-bit Orchid ProDesigner VGA card that output to a NEC MultiSync 2A display, and a combination hard/floppy disk drive controller for each one of the 5.25- and 3.5-inch TEAC floppy disk drives, as well as the aforementioned MiniScribe hard disk. In addition to the two serial ports, the slotted I/O card had a parallel port and a game port.

The drive bays of the NetSet 333 are interestingly configured. Internally, the system can hold either a half-height or full-height 5.25-inch floppy disk drive. One exposed bay holds one full-height and one half-height 3.5-inch floppy disk drive, and the other holds two half-height or one full-height 5.25-inch floppy disk drive mounted sideways. A relatively quiet fan runs below the 5.25-inch drive bay, blowing directly at the expansion slots.

Fortron bundles DOS 3.3, *PC-Kwik* disk caching software, and On-Track's *On-Track Disk Manager* with the system. The company offers a one-year parts-and-labor warranty, with on-site service by GE Computer Services, as well as a toll-free support line. The CAD-minded can opt for a 1,024 by 768 graphics board and 19-inch monitor combination for \$2,500.

For guaranteed compatibility, a competitive service policy, and low price, the NetSet 333 is an attractive alternative for the individual user or for those looking for inexpensive network hardware solutions.

HIMS TECHNOLOGIES INC.

HIMS Cache Pro 386/33

by Mitt Jones

When you're a newcomer to the compatibles field, you have to do something in order to distinguish yourself from the others if you expect to make a living. HIMS Technologies' Cache Pro 386/33 ranks among the fastest systems we've tested, comes with a one-year parts-and-labor on-site warranty, and sells for a bargain-basement standard configuration price of \$4,685.

The \$5,995 tower model sent as a test unit uses the same 250-watt power supply and case as the Destiny 386-33, also reviewed in this issue. The case, a \$695 option geared for LAN server installations, has room for ten half-height bays, six with front-panel access. The hinged doors of



the chassis also make getting to the internals of the machine a breeze. If you're not the trusting type, however, make sure the people you're wary of aren't using the same chassis: when I failed to find the case-lock key upon unpacking the machine, I discovered that the key to the Destiny model also unlocks the HIMS case.

Though it turned in middling times on video and hard disk tests, the Cache Pro beat out every other 33-MHz machine that *PC Magazine* tested in both the 80386 Instruction Mix and Floating-Point Calculation tests. The secret to its success is twofold. First, our test unit came packed with the maximum allowable static RAM cache of 256K. Second, the cache uses the write-back technique rather than the more common write-through. Discrete components govern operation of the cache, making for additional speed.

The motherboard accommodates up to 8MB of 80-nanosecond page-mode system memory using 1-megabit SIMMs. A high-speed, 32-bit expansion slot allows installation of an additional 8MB on a HIMS proprietary add-in board. The coprocessor slot accepts either the Intel 80387 or Weitek 3167 coprocessor.

In disappointing contrast to the fast processor, the disk subsystem supplied with our evaluation unit—a Data Technology Corp. 6280 ESDI controller and a full-height, 16-millisecond 170MB Maxtor 4170E hard disk—proved among the slowest of the crowd. HIMS ships a copy of *PC Tools Deluxe*, Version 5.5, with each machine, however, and offers a disk caching controller as an \$850 option.

Our test unit came with a Video Seven V-RAM VGA adapter, fully loaded with 512K RAM for a maximum resolution of 1,024 by 768, and a 14-inch Sony multiscanning monitor.

The keyboard, a Focus Electronic 101-key model, has a surprisingly good feel. Its

distinguishing feature, however, is a hinged plastic cover that protects the keyboard from dust. The idea sounds good, but once you flip the cover back, it can't seem to stay out of the way.

HIMS has gone to the trouble and ex-

The \$5,995 HIMS Cache Pro 386/33 is one of the fastest 33-MHz 386s ever tested by PC Labs. With its Super Tower chassis, featuring ten half-height drive bays, and a 250-watt power supply, the Cache Pro is ready for budget-minded power users.



FACT FILE

HIMS Cache Pro 386/33

HIMS Technologies Inc., 368 Montague Expressway, Milpitas, CA 95035; (800) 367-2924, (408) 946-9711.

List Price: With 1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS 4.01, \$2,895; with 4MB RAM, 120MB hard disk, VGA monitor, \$4,685; with Super Tower chassis, 150MB hard disk, 512K VGA adapter and multiscanning monitor, \$5,995.

In Short: The HIMS Cache Pro 386/33 offers exceptional value, ranking among both the least expensive and fastest of the 33-MHz lot. Comes with a one-year on-site parts-and-labor warranty. Available via direct order or through dealers.

CIRCLE 406 ON READER SERVICE CARD

pense of producing a custom three-ring binder and sheath for its documentation. However, the documentation we received was preliminary; a major rewrite is being made.

If you're looking for a low-cost LAN server, the HIMS Cache Pro rates as an excellent buy, especially considering its one-year on-site warranty. You'll be getting a solid machine made by a company willing to back it.

MICRO EXPRESS

Micro Express ME 386-33LC

by M. David Stone

If you think of a 33-MHz 386 as a network server or power user's system, then you probably think it needs lots of drive bays and slots—never mind its size. So what's the Micro Express ME 386-33LC doing in a small-footprint case? Playing the computer analog to a two-seat sports car, and very nicely, thank you.



The small-footprint Micro Express ME 386-33LC sacrifices little to fill its reduced-size case. With 4MB RAM, a 100MB hard disk, and a VGA monitor, the system costs only \$4,993 and still provides five drive bays and four free expansion slots, as well as on-site service and a two-year warranty.

Priced at \$5,494 as reviewed—with DOS 3.3, a 150MB hard disk, and a NEC MultiSync 2A monitor—the ME 386-33LC asks you to give up surprisingly little for its small footprint. Measuring 6.75 by 14.75 by 16 inches (HWD), the chassis offers three fully accessible 5.25-inch half-height drive bays and two 3.5-inch drive bays, one of which is accessible.

The largest 3.5-inch hard disk that Micro Express offers is 100MB; however, Micro Express expects to offer larger-capacity 3.5-inch drives as they become available.

One drawback to the second 3.5-inch bay is that it limits two of the eight slots on the Micronics motherboard to half-size cards. In the review system, one of these was filled with the JCC I/O board, with one serial and one parallel port, plus a second serial port and a game port attached by ribbon cable.

Three of the remaining slots on the review system contained a Paradise VGA Plus 16 card, a Data Technology Corp. (DTC) disk controller card, and a Micronics memory card that supports up to 8MB of 80-nanosecond DIP RAM, plus 8MB on an optional daughterboard, for a maximum of 16MB.

The motherboard sports an Intel 82385 cache controller and room for up to 64K of 25-ns. cache RAM. The review system came with the minimum 32K cache. Sockets are available for the optional 80387 or Weitek 3167 coprocessors, which can be installed separately or together by using the Weitek daughterboard.

On the PC Labs benchmark tests, the ME 386-33LC generally fared well, with

COVER STORY 33-MHz 386 PCs



FACT FILE

Micro Express ME 386-33LC

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; (800) MICRO-21, (714) 852-1400.

List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and serial port, utilities, DOS 3.3, \$2,824; with 4MB RAM, 100MB hard disk, VGA monitor, \$4,993; with 150MB hard disk, \$5,494.

In Short: The small-footprint Micro Express 386-33LC, available directly from Micro Express, offers solid performance in an appealingly small package. And the two-year warranty with one-year on-site service makes the package even more attractive.

CIRCLE 410 ON READER SERVICE CARD

one exception: the CDC 150MB drive turned in one of the worst scores in the group on the small-record DOS File Access test. If disk performance is a key issue, Micro Express offers the DPT disk controller with on-board cache as an option. And note that in two of the three processor and memory tests, there was no significant difference between the ME 386-33LC and the fastest machines tested.

One interesting, no-cost option is the Chicony trackball keyboard, which offers both a Microsoft mouse mode and a Mouse Systems PC Mouse mode. The trackball eliminates the need for a cleared area on your desk for a mouse, but the resulting layout scrambles the function keys.

The ME 386-33LC is a creditable system in an appealingly small box. And the two-year parts-and-labor warranty with one year on-site service is a plus. This time around Micro Express proves that big performance doesn't have to come in a big package.

MICRO 1 INC.

Micro 1 Power 386/33

by Alfred Poor

Micro 1 came out of nowhere in 1988 to build a line of aggressively priced 386 PCs. Its Micro 1 386-16 with an amazing \$1,530 price tag, won an Editor's Choice in May 30, 1989 and held up to scrutiny over the course of an Endurance Test (January 16, 1990). The company's meteoric rise led to some rocky times in 1989, but it completed a re-organization and is now delivering a machine with decent perform-

ance and an impressive list price of \$5,790 for a 4MB RAM, 100MB hard disk configuration.

One of the most impressive details of the Power 386/33 machine, built around a Mylex motherboard, is its disk controller. It comes with a whopping 4MB on-board cache, which gives it a significant performance boost. The fact that this cache resides on a 32-bit card means that it is nearly twice as effective as 16-bit designs. The controller uses a SCSI interface, making it possible to daisy chain as many as seven hard disks at once.

You'll be able to fit numerous disk drives in the Power 386/33's 24.5- by 7.5- by 16.7-inch (HWD) tower case. Its familiar, front-door design locks shut to cover the drive bays and controls. You can access all ten half-height bays when the door is open.

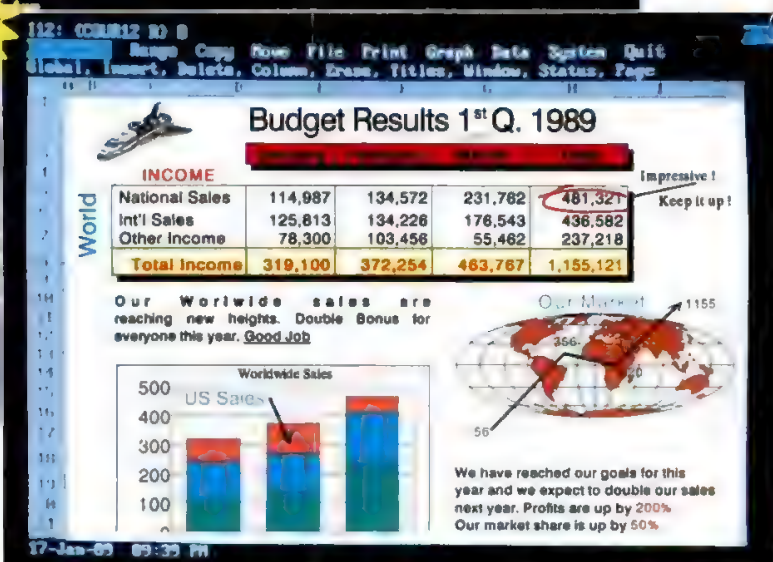
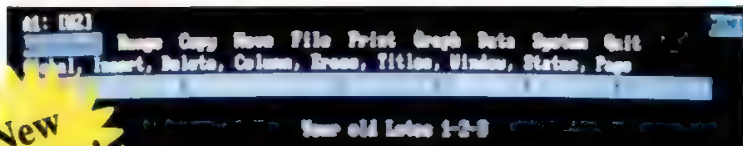
There are also reset, keyboard disable, and power switch disabling switches hidden behind the door. Unfortunately, the review unit we received did not have any labels on these switches; a company representative said that this was an oversight and that the units normally have silk-screened switch labels right on the case.

The case contains a 250-watt power supply with two fans, and Micro 1 offers a 350-watt model as an extra-cost option. A thermocoupled sensor in the case monitors the machine's inside temperature, and as the temperature rises, the fans run faster to



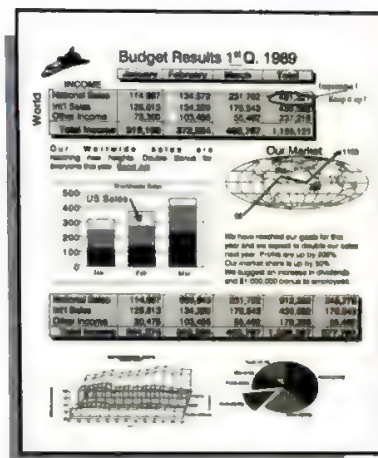
Micro 1's Power 386/33 loads 8MB RAM and a 330MB SCSI hard disk with a 4MB disk caching controller in its tower case. With two fans, a 250-watt power supply, and ten drive bays, this \$8,970 system gives you room to grow, although the four free expansion slots aren't enough for a large network.

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IMPRESS works with: 1-2-3 release 2.0, 2.01 or 2.2, DOS 2.0 or later, CGA, EGA, VGA or Hercules (No color in CGA). Supports all graphics printers that work with 1-2-3: including Dot Matrix, Plotters, Desk Jet, Laser printers (Hewlett Packard, Postscript, etc.). Color printers. IMPRESS occupies 93k RAM above 1-2-3 (uses EMS if available). Many Bitstream Fonts included with package. 1-2-3 is a registered trademark of Lotus Development Corp. Allways is a registered trademark of Funk Software.

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	Allways	IMPRESS
1-2-3 stays fully functional & interactive	No	Yes
Enhance & customize 1-2-3 screen display	No	Yes
Print sideways on all printers	No	Yes
Synchronized live graphs	No	Yes
See more rows & columns on screen	No	Yes
Drawing tool box	No	Yes
Import Freelance images or graphs	No	Yes
Word processing capabilities	No	Yes
Customize graphs with arrows, frames, drawings	No	Yes
Full mouse support	No	Yes

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5/16/89 — PC Magazine

"IMPRESS ... a clear leader worthy of an excellent score. If you like Allways, you'll love IMPRESS."

9/4/89 — Infoworld

"Works magic ... the tremendous improvement over 1-2-3's screens and reports is obvious."

3/89 — Lotus Magazine

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FACT FILE

Micro 1 Power 386/33

Micro 1 Inc., 962 E. Isabella Ave., Mesa, AZ 85204; (800) 338-3597, (602) 926-6440, (602) 497-4131

List Price: With 2MB RAM, 100MB SCSI hard disk, 1 2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, monochrome VGA monitor, one game, two parallel, and two serial ports, extended memory manager, \$4,940; with 4MB RAM, VGA monitor, DOS 4.0, \$5,790; with 8MB RAM, 330MB SCSI hard disk, VGA monitor, \$8,970.

In Short: The Micro 1 Power 386/33 carries significant smarts in a big box with a surprisingly small price tag. The system's intelligent 32-bit disk controller speeds disk access, and the price includes on-site service from TRW. All in all, the Power 386/33 is an attractive, low-price alternative.

CIRCLE 408 ON READER SERVICE CARD

cool the unit more effectively.

Micro 1 is clearly trying hard to make amends for prior problems, but with mixed results. For example, our test unit arrived with a monitor cable that needed an adapter to attach to the installed VGA card. Micro 1 included the adapter, but we couldn't fit the cable to the adapter with the top of the case in place. Still, the Power 386/33 includes an on-site service contract through TRW, so had we been a paying customer, TRW would have brought the correct cable to our door.

Even with its flaws, the Power 386/33 represents an attractive value. The fact that you get a full year of on-site warranty service at no extra cost should go a long way toward easing any lingering doubts about the company's stability. If you are buying on price, this is one to consider.

NATIONAL MICRO SYSTEMS INC.**Flash 386-33**

by Lori Grunin

Upon opening the case of National Micro Systems' Flash 386-33, the first thing you notice is the DPT SmartCache controller—a surprising but welcome addition to the 4MB RAM configuration priced at \$6,242. When this controller is combined with the 18-millisecond 150MB ESDI hard disk drive by CDC, you get a zippy disk subsystem.

The rest of this 6.25- by 20.5- by 16.5-inch (HWD) system, however, performed like an average 33-MHz machine. Our

\$6,820 test configuration included an 80387 coprocessor (the machine will also support a Weitek 3167), as well as 4MB of 80-nanosecond DIP chips on a card that plugs into the 32-bit slot of the Micronics motherboard; the Micronics board doesn't take on-board RAM. The card accepts a maximum of 8MB using 1-megabit chips, and you can reach a maximum of 16MB of memory by using an optional daughter-board.

A 64K RAM cache composed of 32K of 25-ns. RAM and 32K of 35-ns. RAM rounded out the memory components. Mixing speeds in cache chips is unusual but not alarming; the company did so because it didn't have enough 25-ns. chips on hand at review time. The CPU can ostensibly be toggled between 8 and 33 MHz using the SETSPEED utility, but I couldn't make SETSPEED work. The bus itself can run at either 8.25 or 11 MHz, chosen by flipping DIP switches, and even though a

strict 8 MHz is required in those rare circumstances when compatibility becomes an issue, 8.25 seems superfluous.

You can fit up to five accessible half-height 5.25-inch drives in the drive bays; nonetheless, it seemed a waste of space for the company to install a full-height 150MB drive. And placing all the memory on a card automatically reduces the number of available expansion slots to seven, but the chassis has eight cutouts for slotless ports. One slot went to Western Digital's 16-bit TopVGA card, connected to a Sony VGA display. Another slot went to the I/O card, which featured one parallel and two serial ports, and—recognizing that even serious power-hungry users like to play—a game port.

You may choose DOS 3.3 or 4.01, and the system comes with Phoenix's setup utility, Micronics MICEMM expanded memory manager, and an excellent diagnostic utility from DiagSoft called *QA Plus*. Service terms aren't the most convenient: although the company offers the standard one-year parts-and-labor warranty, you need to ship the machine back to



FACT FILE

Flash 386-33

National Micro Systems Inc., 2833 Peterson Pl., Norcross, GA 30071; (800) MICRO-49, (404) 446-0520.

List Price: With 4MB RAM, 1.2MB 5.25-inch floppy disk drive, DPT SmartCache controller with 512K RAM, one parallel and two serial ports, Micronics MICEMM expanded memory manager, DOS 3.3 or 4.01, \$4,040; with 150MB hard disk, VGA monitor, \$6,242; with 8MB RAM, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, \$6,820.

In Short: An inexpensive desktop system with respectable performance; however, its limited service provisions make it a bad choice for the risk-averse and accident-prone.

CIRCLE 411 ON READER SERVICE CARD

the manufacturer for repairs. National Microsystems sells only direct to end users.

Since the Flash 386-33's low price includes the DPT controller, the machine can serve as an inexpensive option for us-

National Micro Systems' Flash 386-33 can serve as an inexpensive option for users whose computing involves intensive file I/O.

ers whose computing involves intensive file I/O. Unfortunately, CAD users will have to go elsewhere for high-resolution video accessories.



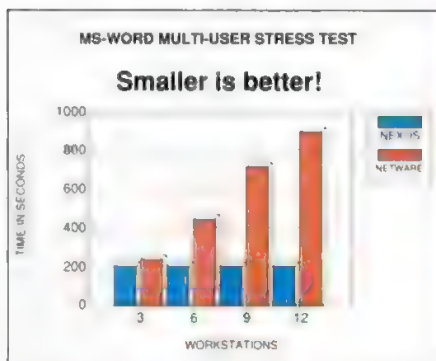
Like many of the systems reviewed here, National Micro Systems' Flash 386-33 was tested with a DPT caching controller. You must return the machine to National Micro Systems for any service, but for \$6,242, the Flash 386-33 offers good performance at a low price.

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tion logging to the server's tape drive. With NEXOS your critical data is safe!

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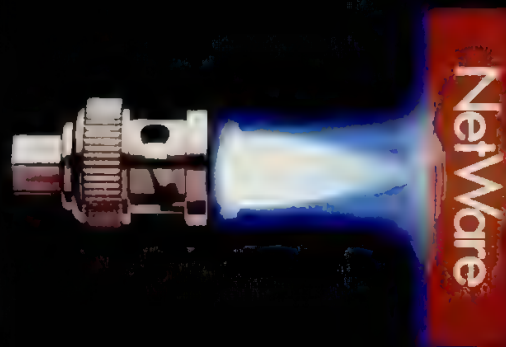
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Oak MicroSystems D386/33/4

by Catherine D. Miller

The Oak MicroSystems desktop-model D386/33/4 packs its 33-MHz muscle into a small-footprint case. If desk space is less important than maximum expandability, Oak also offers the system in a tower case.

Our \$8,543 test unit came in a 6.5- by 14.75- by 16.25-inch (HWD) case with two 3.5-inch and three 5.25-inch half-height drive bays. A 3.5-inch 1.44MB TEAC floppy disk drive occupied one 3.5-inch bay and a 1.2MB 5.25-inch Mitsumi floppy disk drive occupied a 5.25-inch bay. All but one of the 3.5-inch bays are accessible from the front of the case.

The 25- and 15-pin I/O port cutouts located at the back of the case are used for serial game ports; our test unit also included a 9-pin serial and one standard parallel port.

The D386/33/4's case is attractive but not particularly sturdy. The location of the power switch is such that you can easily hit it with the keyboard, turning the system off. A reset switch and a turbo switch that



turns the cache on or off also grace the front panel.

Samsung's 80-nanosecond 1-megabit DRAM chips filled all 4MB of DIP sockets on the Hauppauge motherboard. The 80387-25 coprocessor was located under the drive bays, but the empty Weitek 3167 socket was easily accessible. Intel's 82385-33 cache controller managed 64K of 15-ns. 64K SRAM DIP chips. The board has one 8-bit slot, six 16-bit slots, and a 32-bit slot that can function as an 8-

POWER STORY 33-MHz 386 PCs

bit slot. Two 16-bit expansion slots are limited to half-length cards by a 3.5-inch drive bay.

Video was provided by the ATI VGA Wonder-16 card and the Princeton Graphics Systems Ultrasync multiscanning monitor. The 16-bit VGA card, which sports a mouse port as well as 9-pin digital and 15-pin analog ports, comes with a Bus Mouse as well. DOS 4.01, utilities, and setup software were also included with the Oak system.

Although one of the slowest on processor and memory benchmark tests, the Oak MicroSystems 386/33 was one of the fastest on disk benchmark tests. The fast disk performance can be attributed to Distributed Processing Technology's SmartCache caching 512K disk controller and the ESDI MiniScribe 155MB hard disk, with its 16.5-millisecond average access time.

A preliminary version of the manual supplied some helpful information, but many procedures, such as coprocessor installation, weren't adequately described.

Oak MicroSystems distinguishes itself by offering a two-year parts-and-labor warranty. It sells its machines through dealers, distributors, and volume buyers. Technical support is available, but a toll-

The Oak MicroSystems D386/33/4 packs 33-MHz 386 power into a small-footprint case for only \$8,543. The MiniScribe 155MB ESDI hard disk with a 512K DPT caching disk controller and a two-year warranty are the highlights of this PC, which is also available in a tower configuration.

PC FACT FILE

Oak MicroSystems D386/33/4

Oak MicroSystems Ltd., 13 Technology Dr.,
Setauket, NY 11733; (516) 689-6171.

List Price: With 4MB RAM, 1.2MB 5.25-inch or 1.44 3.5-inch floppy disk drive, one parallel, one game, and two serial ports, \$4,995; with 4MB RAM, 100MB hard disk, VGA monitor, DOS 4.01, \$6,769; with 155MB ESDI hard disk, DPT SmartCache controller with 512K cache, Princeton Ultrasync monitor, 80387 25 coprocessor, bus mouse, \$8,543.

In Short: The Oak MicroSystems machine's small-footprint case houses five drive bays but suffers from a poorly placed power switch. A two-year parts-and-labor warranty and on-site service add to its attractiveness.

CIRCLE 413 ON READER SERVICE CARD

free number is not. On-site service is available through Intel and Jamaica Water and Power (JWP).

While its overall performance doesn't recommend it, the Oak MicroSystems D386/33/4 comes in a small-footprint case and carries a two-year warranty. If desk space and service are your main concerns, the Oak MicroSystems D386/33/4 is worth considering.

OLIVETTI USA

Olivetti M380/XP9

by Alfred Poor

The \$13,050 Olivetti M380/XP9, equipped with 4MB of RAM and a 135MB hard disk, may be stuck with a moniker that reminds you of a transmission part number, but its highly styled case may make you think of Gucci loafers and other examples of expensive Italian design.

The tower case's mustard-and-gray color scheme may not match everyone's fashion preference, but its layout is ideal. Like many of the recent tower designs, cable connectors are located at the top, covered by a removable lid. Unlike other designs, however, it is easy to route the cables out of this cavity; a castellated ridge of plastic on either side offers rounded openings for your wires.

Inside, expansion cards mount vertically with brackets at the top. There are 11 slots, so you're unlikely to fill them too quickly. Two are 8-bit, and there are four each of 16-bit and 32-bit slots. The 32-bit slots can accept either 8-bit or 16-bit cards. The second 8-bit slot is specially designed to accommodate the front console controller. The console's panel offers a readout of system messages, such as the power-on self-test operations. According to an Olivetti representative, you can also write programs that display messages on the console.

Another unusual aspect of the M380/XP9 is that the expansion slots are not on the motherboard. They are on a passive backplane that plugs into a short card known as "the U-turn card." This connects to the motherboard, which is mounted on the other side of the tower case; you remove the other side panel to gain access.

The motherboard carries the CPU, and has room for an 80387 and a Weitek 3167 math coprocessor, both of which can be in-



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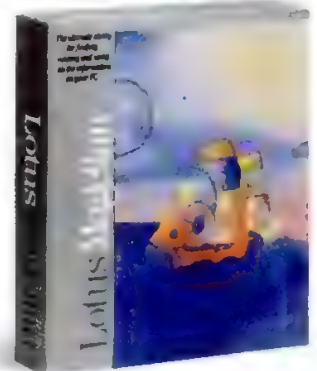
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Lotus Magellan



At \$13,050, fully configured with VGA and 135MB ESDI hard disk, the Olivetti M380/XP9 offers good design features for a tower file server, including vertically mounted expansion cards with their connectors at the case top. However, CPU performance could be better.

stalled simultaneously. The motherboard also carries up to 8MB of memory, plus an additional 32K for a processor RAM cache controlled by an 82385 chip. If you should need more system memory, you can add up to three 32-bit memory cards, each of which holds up to 16MB of memory.

Unfortunately, what's most notable in the M380/XP9 is what's missing. As a single-user station, it lacks setup in ROM, and the documentation is not as thorough as it might be in some areas. As a file server, it lacks full security features, such as a case lock—although it does have a keyboard lock and password provision in ROM. It can hold but two full-height and three half-height devices: add two hard disks, a floppy disk drive of each size, a



FACT FILE

Olivetti M380/XP9

Olivetti USA, 765 U.S. Highway 202, Somerville, NJ 08876; (800) 527-2960, (201) 526-8200.

List Price: With 4MB RAM, 135MB ESDI hard disk, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, monochrome VGA monitor, one serial, one parallel, and one mouse port, extended memory management software, \$12,495; with VGA monitor and DOS 4.0, \$13,050; with 304MB ESDI hard disk and 80387 coprocessor, \$18,850.

In Short: The Olivetti M380 XP9 has an unusual case and some interesting design features, but it fails to provide any remarkable results in performance and dollar value, making it a less attractive buy than its competitors.

CIRCLE 413 ON READER SERVICE CARD

COVER STORY

33-MHz 386 PCs

tape drive, and your system's full.

Most of all, the M380/XP9 falls short in performance. While there is no great difference in the times for this group of machines, the Olivetti finished near the bottom in every CPU benchmark test. Video and disk speeds were better in some cases, but still not stellar.

For this kind of money, you deserve more than stylish looks. The M380/XP9 is an interesting machine with some convenient design ideas, but it is not yet a competitive machine in this class.

PC CRAFT INC.

PC Craft 5000/33C

by Bill O'Brien

Outside, the PC Craft 5000/33C is a stark tower with only a single half-height 5.25-inch high-density floppy disk drive breaking the flat pattern of its beige case. But the \$12,250 price for the review machine, including 4MB of RAM and a 135MB ESDI hard disk, proved that looks can still deceive.

Start with the Mylex motherboard which, powered by a Phoenix BIOS, sported a full 128K processor cache. The effect of this enhancement is that although the results of the Instruction Mix benchmark test, which indicates processor performance, were on the slow side, the Conventional Memory Access test result was pushed into the top 20 percent of the group.

The Mylex board has several features worth mentioning other than its large cache capacity. As with some other motherboards, no RAM is installed on the board itself. Instead, a 32-bit slot for a memory board can be maximized to 32MB with 4-megabit chips. Two additional 32-bit slots on the board can function as 16-bit slots as well. Six half-height drive bays—four available—round out the broad expansion capabilities of this machine.

Mylex has devised a unique, albeit controversial, method of overcoming the 8-MHz compatibility bottleneck. If you want adherence to the IBM standard, the 8-MHz version of the 5000/33C is for you. Should you change your mind later, optional plug-in crystals are available to make the 5000/33C race along at 10, 12, or even 16-MHz bus speeds.



Look inside the stark case of the PC Craft 5000/33C and you'll find a 128K memory cache and a 4.5MB DPT disk caching controller in addition to the 4MB RAM; there's also a 135MB ESDI hard disk. Add DOS and VGA for a high-performance system that sells for \$12,250.

A DPT hard disk controller crammed with 4.5MB of memory, a pricey option included in our review machine, typically produces ultrafast performance results. However, PC Labs tested the machine with only 512K of cache RAM active. The 135MB Micropolis ESDI drive responded with superlative numbers in the small-record DOS File Access test, but the large-record-handling test results suffered significantly when the data exceeded the cache size. With all 4.5MB active, you should expect significantly improved large-record access times.

The configuration tested for this review will probably prove too expensive for the average user making a price/performance comparison. Indeed, individuals might be better served by a machine in the \$6,000 range. File server seekers can bump the price of the reviewed 5000/33C up another



FACT FILE

PC Craft 5000/33C

PC Craft Inc., 640 Puente St., Brea, CA 92621; (800) 733-6666, (714) 256-5000

List price: With 4MB RAM, 1.2MB 5.25-inch floppy disk drive, \$4,625; with DPT hard disk controller with 4.5MB RAM, 135MB ESDI hard disk, VGA monitor, \$12,250

In Short: The PC Craft 5000/33C offers competent performance characteristics and is a competitive machine with a wide range of available options.

CIRCLE 414 ON READER SERVICE CARD

\$4,000 with a 765MB ESDI disk. Its large disk-caching capabilities make it a contender for applications with heavy file access, but its high cost may prove daunting for single users.

PC MAX

PC Max PM 386-33/M

by M. David Stone

The ingredients for lesser-known computer brands often sound like a recipe mixed in some high-tech computer kitchen. For the PC Max PM 386-33/M, start with one AT-style chassis, a Micronics motherboard, and a 230-watt power supply. Add serial and parallel ports, a disk controller, and two TEAC floppy disk drives: one 1.2MB and one 1.44MB. Garnish with a 101-key Focus Electronic keyboard or Maxi-Switch silent keyboard, and you'll have the bare bones of a PC Max offering.

\$5,300 is the asking price for a PC Max PM 386-33/M with 4MB RAM, a Toshiba 144MB hard disk, a NEC MultiSync 3D monitor, and DOS 4.01. PC Max currently uses the Micronics system board, but the company plans to begin making its own motherboards.

The \$5,300 price tag on the review system also buys a Toshiba 144MB hard disk, a NEC MultiSync 3D monitor, DOS 4.01, a VGA card, and 4MB of 80-nanosecond RAM installed. And although there is nothing exceptional about this assemblage of mostly off-the-shelf parts, it makes for a perfectly acceptable and reasonably priced 33-MHz stew.

A better indication of just how acceptable the system is can be found on the PC Labs benchmark tests. On two of the three CPU tests, the difference between the fastest scores and the PM 386-33/M's scores were minor, and on the third test, the difference was barely significant. On the disk and video tests, the PC Max was generally midrange or better, except for the BIOS Disk Seek test, where it was slow.

The PM 386-33/M's 6.75- by 20.5- by 16.25-inch (HWD) chassis offers the typical five half-height drive bays. Unfortunately, the chassis itself is too flexible to furnish solid support for the motherboard. If you move this system, be certain to reseat the boards.

COVER STORY

33-MHz 386 PCs



FACT FILE

PC Max PM 386-33/M

PC Max, 8025 Deering Ave., Canoga Park, CA 91304; (800) 777-1288, (818) 888-8880.

List Price: With 2MB RAM, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, one parallel and two serial ports, DOS 3.3 or 4.01, \$3,105; with 4MB RAM, 120MB hard disk, VGA monitor, \$5,000; with 144MB hard disk, multiscanning monitor, \$5,300.

In Short: The PM 386-33/M is a perfectly acceptable desktop system with good performance and reasonable price but little to distinguish it from the crowd. The combination of direct distribution and ship-back service may cause a problem for some users.

CIRCLE 415 ON READER SERVICE CARD



According to a PC Max representative, the company plans to build its own motherboards beginning in 1990. Until then PC Max will continue to use a Micronics motherboard. The board includes a co-processor socket for either an 80387 or a Weitek 3167, though neither was installed in the review system.

The motherboard includes the Phoenix ROM BIOS, an Intel 82385 cache controller, and 64K of 25-ns. cache. A separate memory board holds up to 8MB of DIP-type RAM on the card itself and 8MB more on an optional daughterboard. In addition to the dedicated memory slot, the Micronics board has five 16-bit slots and two 8-bit slots. One of these was occupied in the review system by a National Computer Ltd. disk controller, though PC Max says that it also uses Western Digital controller cards. Two other slots were filled by a SEFCO serial/parallel card and a SEFCO 16-bit SVGA card. SEFCO is a separate company but shares the same ownership as PC Max. SEFCO will manufacture the upcoming PC Max motherboard.

System support is another area that could use improvement. The one-year warranty for parts and labor is all to the good, but service is limited to shipping back to any of several locations in the U.S. If on-site service is an important consideration, this is obviously not your computer.

The PC Max PM 386-33/M will give good performance at a competitive price, but you might prefer to pay more for a stronger machine and better service options.

SPEAR TECHNOLOGY INC.

Spear 386/33U

by Henry Fersko-Weiss

The Spear 386/33U is a computer with processor performance results in the middle of the pack but a list price that's hundreds of dollars less than comparable machines. Its standard configuration, with 4MB of RAM, a 110MB hard disk, 5.25-inch 1.2MB floppy disk drive, VGA monitor and DOS costs only \$4,700. This is considerably less than the most expensive computer in our review group, and that makes it one of the least expensive 33-MHz computers you can buy.

Since the 386/33U is a tower model measuring 25.25 by 7.5 by 16.5 inches (HWD), it presents excellent expansion potential. There are eight available expansion slots, eight cutouts, and five drive bays. Spear offers an almost bewildering array of options to fulfill this expansion potential. You can get 18 hard disk options with capacities as high as 766MB on an SCSI drive, three internal tape drives, an 800MB CD ROM drive, and several types of multiscanning monitors.

Four of the eight slots in the standard configuration are taken up by the disk drive controller, the video card, the I/O card, and the memory card. The 386/33U uses a slightly altered Micronics motherboard, which puts memory on a daughterboard, allowing up to 8MB of RAM before you have to use an additional slot for more RAM.

One difference between this motherboard and other versions of the Micronics is the relatively small 32K maximum RAM cache. For a system that uses direct-map cache management, this can cause some bottlenecks. Yet the 386/33U didn't do badly on our Conventional Memory test, coming in near the upper-middle

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25MHz. The 25 MHz KEEN-2500 has the same cache memory scheme as the 33 MHz unit. It delivers 6.2 MIPS and a Landmark Speed of 43.5 MIPS Magazine called it: "... one of the best high-performance bargains we've seen."

It's available in desktop and tower configurations and is Novell certified for use with NetWare. And XXCAL Testing Labs certified it for compatibility with a long list of hardware products, operating systems and, of course, the latest high-performance software.

The tower model supports up to five half-height drives and both desktop and tower models are fully featured to carry you far into the future. It's a lot of box for the buck.

20MHz. DTK offers two top-performing 20 MHz systems that are both exceptional values. The KEEN-2030B is a small footprint model with two

serial and one parallel ports and a 32-bit

RAM card for up to 8 MB of DRAM. With a Landmark Speed rating of 25.5 MHz, it delivers full 32-bit performance at a 386SX price. And it's FCC Class B certified for home use.

The KEEN-2000 has two serial and one parallel ports and eight expansion slots including two 32-bit slots for up to 17 MB of local memory. Its Landmark Speed rating is 27.3 MHz, and it's available in desktop or tower models.

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CIRCLE 102 ON READER SERVICE CARD



FACT FILE

Spear 386/33U

Spear Technology Inc., 710A Landwehr Rd., Northbrook, IL 60062; (800) 282-1212, (312) 480-7300.

List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, DOS 4.01, \$3,200; with 4MB RAM, 110MB hard disk, VGA monitor, \$4,700; with 150MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, multiscanning monitor, \$5,300.

In Short: The Spear 386/33U is one of the least expensive 33-MHz computers on the market. Its performance is generally in the middle range, but its MaxLogic video card had the best Direct to Screen benchmark test result in our review group. As a tower machine, this computer has very good expansion potential, which is complemented by Spear's numerous add-in options.

range—only about 20 percent slower than the fastest machine in this group.

Spear has gone to Phoenix Technologies for its BIOS, Everex for its I/O card, and Key Tronic for its keyboard. Another quality part of the 386/33U's system is the MX-677 video card that came with the model we tested. Manufactured by Max-Logic, the card had the fastest time of any in our review group on the Direct to Screen benchmark test. Because it had 512K of memory it was also able to display text 132 columns wide and support 16-color 800 by 600 resolution on a multiscanning monitor. The MX-677 software has drivers that let a number of the most popular software



The Spear 386/33U offers more for less. The tower system sent to PC Labs came complete with 4MB RAM, 150MB hard disk, two high-density floppy disk drives, Super VGA and a NEC MultiSync 3D monitor, and DOS 4.01, for only \$5,300.

COVER STORY

33-MHz 386 PCs

programs take advantage of the card's high-resolution capability, including *Microsoft Windows*, *GEM*, *Ventura Publisher*, *WordStar*, *WordPerfect*, and *Lotus 1-2-3*.

Apart from the fast video test results, the Spear 386/33U tested in the middle of the pack. But if the machine doesn't have stellar test times, it certainly has exceptional pricing. Add to this the strong expansion potential of the machine and the flexibility that comes from Spear's multitude of add-in options, and you have a computer well worth buying.

ULTRA-COMP COMPUTER
HARDWARE

Ultra-Max 386-33

by Stephen W. Plain

Released just as this roundup of 33-MHz 386s got underway, the Ultra-Max 386-33 from Ultra-Comp has come into the market with one major attraction: its price. For \$4,781 this unit offers 4MB of RAM, a 120MB hard disk, a 1.2MB or 1.44MB floppy disk drive, one parallel and two serial ports, and VGA.

Our test machine also came equipped



The Ultra-Max offers a real surprise when you

turn the unit on: it's so quiet it'll send you checking to see whether you remembered to plug it in.



EDITOR'S CHOICE

• Acer 1100/33

Of the 22 machines in this roundup of 33-MHz 386-based PCs, only the Acer 1100/33 measures up to the Compaq Deskpro 386/33 and the Northgate Elegance 386/33, Editor's Choices in our October 31, 1989, roundup of the first 33-MHz 386s. The Acer 1100/33 stands apart by being the only PC to offer breakneck processor and memory speed, durable construction, and thoughtful design.

Acer's offering shows thoughtful engineering and dedication to fine detail. The case is of heavy-gauge steel and holds five half-height or one half-height and two full-height drives internally. DIP switches are easily accessible on Acer's own system board, and its smart design squeezes top-tier performance out of its 32K memory cache; the machine led with a first place score on the PC Labs Conventional Memory test. Final

touches like system board specs printed inside the case, a bundled copy of *Microsoft Windows/386*, and a mouse make the 1100/33 a first-rate system.

Acer's 1100/33 lists for \$10,365 with 4MB RAM, a MiniScribe 94MB ESDI hard disk, a high-density floppy drive, VGA, and DOS (our standard configuration for this class of machine). Look for discounts on this system through the dealer channels.

Several other machines are terrific values, but for one reason or another fall just short of achieving Editor's Choice credentials. The \$12,095 AT&T 6386E/33 Work Group System is a superb LAN or Unix server, offering eight drive bays and eight open slots, solid construction, and consistently strong benchmark test performance. This huge tower may be too much for a stand-alone user but it is definitely a

with 4MB of 80-nanosecond DRAM, a 150MB MiniScribe hard disk with a Western Digital ESDI controller, a Renaissance GRX 16-bit VGA board, and a Sony Trinitron multiscanning monitor.

The Ultra-Max uses the popular Micronics motherboard, which houses all of the system's RAM—up to 16MB—on a 32-bit proprietary memory board. The Intel 82385 cache controller accepts either 32K, standard, or 64K of 25-ns. static RAM for processor caching. The motherboard accepts either an 80387 or a Weitek 3167 coprocessor, or both.

The Ultra-Max allows for shadowing of both the system and video BIOS into system memory and the selective disabling of either. The CPU runs at either 33 or 8 MHz and has a switchable bus speed between 8.25 and 11 MHz. The Phoenix BIOS means setup is always available with a Ctrl-Alt-Esc keystroke combination. Except for poor video performance, the Ultra-Max landed near the middle of the pack in the PC Labs benchmark tests.

Included with the system was DOS 4.01, Micronics setup and extended memory manager, DiagSoft's *QA Plus*, and Renaissance VGA board utilities, but no comprehensive system user's manual. The Micronics motherboard manual is the user's only reference tool for the operation of the unit.

viable choice for networks.

As we said back in the October roundup of 22 other 33-MHz 386s, performance is the most important factor in deciding which 33-MHz machine is right for you. One one-hundredth (0.01) of a second on the 80386 Instruction Mix test separates the two fastest PCs that have come through PC Labs to date: the HIMS Cache Pro 386/33 and the Eltech Research Model 9970. Both the \$5,995 HIMS Cache Pro and the \$6,535 Eltech Model 9970 achieve this speed through brute force: 256K of 20-nanosecond SRAM cached memory.

The Dataworld Data 386-33 and the Zeos 386/33 both distinguished themselves with blazing disk performance, thanks to optional caching disk controllers driving fast 300MB ESDI hard disks. Dataworld also tacked on the quality NEC MultiSync 4D

COVER STORY 33-MHz 386 PCs

The Ultra-Max is built as an attractive, small tower that is very sturdy. The real surprise, however, comes when you turn the unit on: it's so quiet it'll send you checking to see whether you remembered to plug it in. The tower measures 21 by 7 by 17 inches (HWD) and sports a lighted power switch, turbo button, reset button, and system lock in a row above the floppy disk drives. The Chicony keyboard, whose cable extends up to 72 inches, is

PC FACT FILE

Ultra-Max 386-33

Ultra-Comp Computer Hardware, 11988 Dorsett Rd., Maryland Heights, MO 63043; (800) 435-2266, (314) 991-1988.

List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, Micronics setup and extended memory manager, DiagSoft's *QA Plus*, PFS:First Choice, \$3,149; with 4MB RAM, 120MB hard disk drive, DOS 4.01, \$4,781; with 150MB hard disk drive, VGA monitor, \$5,995.

In Short: While it offers nothing new in the way of technology, the Ultra-Max 386-33 is certainly worth considering because of its affordability. Ultra-Comp is highly flexible in customizing systems to your specifications and has a 30-day money-back guarantee.

CIRCLE 416 ON READER SERVICE CARD

monitor. Although the Dataworld and the Zeos, at \$8,980 and \$8,958 respectively, more than break the \$6,000 barrier in our standard configuration, the as-tested units are great performers.

Among the machines offering incredible price-performance value, Club AT and Spear Technology shatter the \$5,000 mark. The \$4,954 Club AT Model 333C scored A's on PC Labs benchmark tests with a well-built, well-supported 33-MHz powerhouse available in both tower and desktop configurations. The Spear 386/33U also deserves consideration, and one look at its \$4,700 price in our standard 4MB RAM, 110MB hard disk, VGA configuration explains why. With a multitude of options, including a 766MB SCSI hard disk, Spear Technology gives you more for less than much of the competition.

noisy and has a disappointingly low-end feel to it.

Ultra-Comp offers numerous choices of hard disks from 40MB to 330MB and advertises that it will custom-fit the system to your exact needs. The Ultra-Max comes with a one-year warranty, and TRW on-site service is available with a 24-hour response time at \$179 per year. Ultra-Comp also promises to return your money (less a 15-percent restocking charge) within 30 days if you're not satisfied with the quality of your purchase.

While the Ultra-Max 386-33 represents no extraordinary departure in the hardware department, it is a rare bargain in high-end 386s. Proven components and the availability of options make it a logical solution for those who'd like to buy a powerful system and still have some money left over for software.



Ultra-Comp's Ultra-Max 386-33 comes in a quiet, minitower configuration that packs 4MB RAM, a 120MB hard disk, and a VGA adapter for \$4,781. With flexible configurations and competitive prices, Ultra-Comp can have you computing at 33 MHz for under \$5,000.

ZEOS INTERNATIONAL

Zeos 386/33

by Bruce Brown

Zeos International is a major mail-order house with a growing reputation for offering machines with solid value and backing them after the sale. Zeos's 386/33 is a good example of how much value you can get for your money via the mail.

The Zeos 386/33 with 4MB of RAM, a 120MB hard disk drive, and VGA color costs \$5,882 including MS-DOS 3.3, and



Oct. 11, 1988
Dataworld Portacom II



Feb. 28, 1989
Dataworld 386-16



May 30, 1989
Dataworld 386-20



May 30, 1989
Dataworld 386-25

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- 65W power supply
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Here's the deal. Buy any Dataworld system with a value of \$2500 or more and we will ship with the unit a coupon good for a FREE Casio Pocket color television. Just wait 30 days, fill out the coupon with the correct shipping information, mail it back to Dataworld, and we will send you your free TV.

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80386-33

- Intel 80386-33 CPU with 4MB of RAM expandable to 16MB of 32-bit memory
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- 1.2 or 1.44MB floppy drive
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- 275W power supply
- 16-bit VGA adapter w/512K, 1024 x 768 resolution
- NEC Multisync 3D monitor
- Options include hard disks from 20MB to 300MB, tape backup, modem, mouse, Wordperfect key caps, DOS, extra floppy, monitors, game card, coprocessor and tower case
- **\$3939**
- Prices start at \$2795 for mono system with 1MB
- 386-25 From \$2295
- 386-20 From \$1630 (1MB NON-CACHE)



80386SX-16

- Intel 80386SX 16MHz CPU (Norton SI ver 4.0: 18)
- 1MB RAM standard, expandable to 8MB on motherboard
- 80387SX coprocessor socket
- Expansion slots: 6 16 bit and 2 8 bit
- 1.2 or 1.44MB diskette drive
- 200W power supply
- Monochrome card and monitor
- Additional options listed under 80386-33 system
- **\$1295**

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The Zeos 386/33 came into PC Labs fully loaded with 4MB RAM, a DPT 512K cache disk drive controller, 337MB hard disk drive, a NEC MultiSync 3D monitor, and DOS. This mail-order machine is a flexible performer, and Zeos's support won't let you down. At \$8,958 with everything but the kitchen sink, it deserves a closer look.

Zeos's own utility software. That much power in one machine for under \$6,000 is an eye-opener. Our test system came with a 337MB CDC Wren 5 hard drive, a DPT 512K caching drive controller, and a premium-brand NEC MultiSync 3D VGA color monitor.

Interested in performance? The Zeos 386/33 is fast all right, with scores comparable to the other 33-MHz machines on all tests. But the DOS File Access (small records) and BIOS Disk Seek test scores were much better than average because of the special DPT 512K caching drive controller.

As befitting its power and expandability, the Zeos comes in a substantial, tower-style case. Not counting the 1- by 9.5- by 18.75-inch base, the system is 25.5 by 7.5 by 17.5 inches (HWD). The front of the case has a keyboard lock and power-on and reset switches, as well as a turbo switch that is not functional in this system. Instead, to change between normal 33-MHz or the slower 8-MHz speeds, you use a combination of the Ctrl and Alt and +/- keys.

The Zeos system uses an AMI motherboard and runs at zero wait states 81 percent of the time—thanks to its 64K cache memory. The motherboard accommodates both DIP- and SIMM-style 70-nanosecond-or-less memory chips, in either 256-kilobit or 1-megabit sizes. When they are

commercially available, 4Mb chips will work as well. Using both the DIP and SIMM chip banks, you can fit 8MB of memory on the motherboard with 1Mb chips. If you find it necessary, an additional 8MB of memory can fit on a proprietary AMI memory board.

Expansion is accomplished via one 8-bit slot, six 16-bit slots, and one proprietary 32-bit slot for the add-on memory card. The 32-bit slot can also be used for a standard 8-bit card. In all there are six half-height drive bays, three of which are accessible.

The test system came with an ATI VGA Wonder-16 16-bit VGA card, 9- and 15-pin ports, a mouse port, and even a mouse.

Zeos offers a standard one-year parts-and-labor warranty, a 24-hour 365-day-a-year toll-free technical support line with quick replacement for defective parts, and a 30-day money-back guarantee. The company doesn't currently offer an on-site service contract.

The Zeos 386/33 adds up to a good buy from a reputable company. Equipped with a caching drive controller such as the DPT unit, the Zeos machine makes sense either as a stand-alone computer or network file server for applications systems with heavy drive access. Because of its flexible memory expansion capabilities and its competitive price, the Zeos computer earns a hearty recommendation. ■



FACT FILE

Zeos 386/33

Zeos International, 535th Avenue NW, #1000, St. Paul, MN 55112; (800) 423-5891, (612) 633-4591.

List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, 80MB hard disk, 14-inch monochrome monitor, one parallel, one game, and two serial ports, extended memory management and utility software, \$4,495; with 4MB RAM, 120MB hard disk, VGA color monitor, DOS 3.3, \$5,882; with DPT 512K cache disk drive controller, 337MB hard disk, NEC MultiSync 3D monitor, mouse, \$8,958.

In Short: The Zeos 386/33 is a fully expandable tower system sold directly by the vendor. This PC sells for a competitive price and comes with a 30-day money-back guarantee and a 24-hour 365-day toll-free technical support line. For the most part, the Zeos achieved average performance scores for its class but yielded exceptional large-record file access times and BIOS disk seek times when tested with the optional DPT drive controller.

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5164	3 1/3" x 4"	6	100
5165	8 1/2" x 11"	1	100
5267	1/2" x 1 3/4"	80	25

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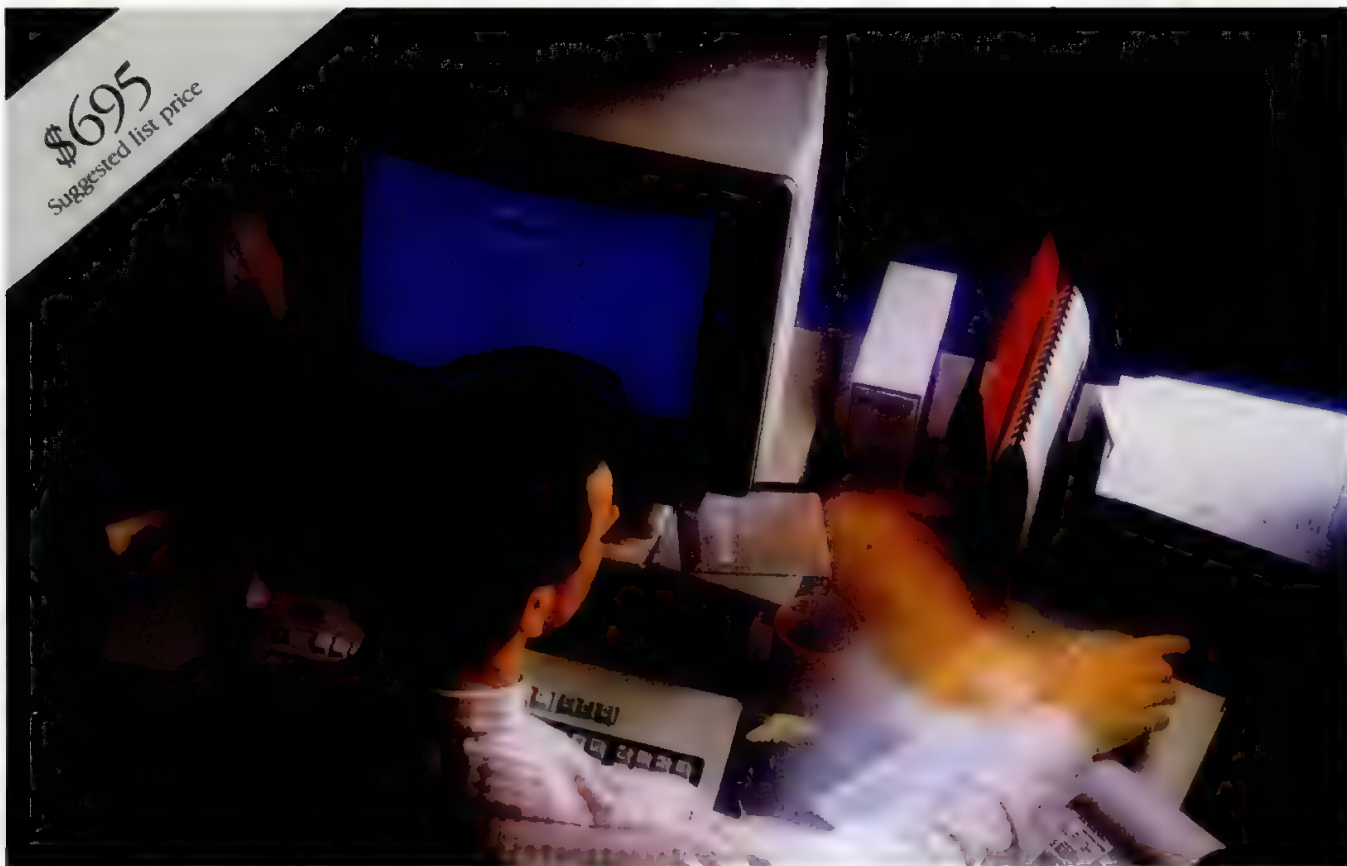
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Windows make their
debuts on 14
new high-resolution
paper-white monitor-
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combinations.**



by Alfred Poor

It wasn't too long ago that the 14-inch, state-of-the-art VGA monitor represented the best display option that the PC industry had to offer to writers, programmers, and designers alike. This was and to some degree remains just fine for text- and number-crunching types. But what about architects, planners, engineers, desktop publishers, and the enormous variety of others who spend their days squinting at only a fourth of their work at any given time? In response to the need to provide full- and even dual-page capabilities, a number of manufacturers have now introduced what a scant five years ago would have been considered behemoth monitors with unheard-of resolutions.

Back in March of 1988, when we last looked at these large monitors, they were practically the exclusive property of desktop publishers. But new drivers and new applications have broadened their usefulness beyond just *Ventura Publisher* and *PageMaker*.

All of these systems offer support for *AutoCAD* and at least some versions of *Microsoft Windows*—though none of them have offered drivers for *Microsoft Windows/386* so far. Many do offer special drivers for use with general DOS programs, and they can be used with *WordPerfect*, *Microsoft Word*, *Lotus 1-2-3*, and other popular applications.

No matter which application you choose, these sys-

tems will make it easier to see the big picture. For this review, we selected those that offer a horizontal resolution of at least 1,000 pixels. A few do better than 1,600 by 1,200, which amounts to about two million pixels—quite a screenful compared with the paltry 300,000 pixels in a standard VGA image.

SCREENING THE SCREENS

To take full advantage of this detail, we required that each monitor measure at least 19 inches diagonally. The 19-inch measure is significant, because you need at least that size to display a legible two-page spread for a desktop publishing program. And even with this deluxe-size screen, you still don't have a full-scale image. Only the 20-inch-diagonal displays were able to produce a full 17-inch-wide image—enough to show two 8.5-inch sheets side by side.

Keep in mind that despite the high resolutions these tubes offered, you can still end up with a surprisingly low dot-per-inch (dpi) image. If you have 1,200 pixels spread across a 17-inch line, you get a display with only about 70 dpi—roughly the same resolution a cheap dot matrix printer would offer. Still, it's actually not the dpi that counts as much as the large viewing area over which those one or two million pixels are spread.

Also be aware that we limited the field to those monitor packages that offer total large-display solutions. You don't have to go to one manufacturer for the monitor and another for the adapter. This can be an important factor because these adapter boards, or cards, are finicky about which monitors they will cooperate with, and you must carefully match the monitor to the card.

Furthermore, your computer itself may determine the monitor-and-adapter combination you choose. Some will operate with or without an additional standard video card, such as CGA or Hercules monochrome; some absolutely require another display card, and still others simply will not tolerate another display card installed in your computer. Problems arising from these limitations are far easier to solve if you have to do business only with a single source. Thus, all of the systems we review here are sold as sets from individual vendors.

As it turns out, the number of full-package players in the field is limited, and there are close relationships between some of the monitors and some of the board

manufacturers. This accounts for much of the similarity among a few of the systems covered.

There are some packages that we did not review because the adapter card uses the Micro Channel architecture bus instead of the standard AT bus. Most of the displays in the MCA category are close relatives of the units we did test, but they operate only with an MCA card. IBM's Models 8506 and 8508 both use the PS/2 Image Adapter/A, which provides a 1,600-by-1,200-pixel image.

In the end, we auditioned 14 different

These monitor-and-card combinations can display their incredibly high resolution images only when you run programs supported by custom screen drivers.

systems. There were some variations in screen size and maximum resolution, but these measurements turned out to be the least important features of all. Instead, one of the most important considerations is the level of gray-scale support.

Display adapter manufacturers tend to describe this capacity in terms of planes, but that simply refers to the number of bits that are assigned to each pixel. A one-plane adapter gives you two pixel states: on and off. It is a small stretch to call this a two-gray-scale design or, more accurately, a black-and-white display. Some of the cards were four-plane, capable of displaying 16 shades of gray, including black and white.

Gray-scale displays are probably most important when it comes to desktop publishing. At present, *Ventura Publisher* supports gray-scale halftone images, while *PageMaker* does not. A halftone gives an even image that more closely resembles a photograph—compared with the dithered images used to show shades of gray on a black-and-white screen. Gray-scaling also makes it possible to fill in the jagged "stair steps" that can be seen on the curved or

slanted edges of letters. Fonts that take advantage of such *anti-aliasing* techniques look much smoother and are easier to read.

PIXEL PERFORMANCE

Even without the extra bits of gray-scale information, it takes a fair amount of computational horsepower to manipulate a million or more pixels at once. As you might expect, different cards approach the challenge differently.

Most made use of the 16-bit AT bus, though a few were limited to an 8-bit connector. Many cards boasted a graphics coprocessor chip such as the Texas Instruments 34010, the Intel 82786, or the Hitachi HD63484. The extra juice generated by these chips helped improve some performance figures—though not always. (See the sidebar "Brains on Board: The Role of Graphics Coprocessors.")

There is clearly more to these systems' performances than coprocessors or bus width. These monitor-and-card combinations can display their incredibly high resolution images only when you run programs supported by custom screen drivers. Drivers typically provide support for *Windows*, *Ventura*, and *AutoCAD*, though most manufacturers offer a variety of other drivers as well. A look at the benchmark test results will show that there are some things the coprocessors can't do so well, and in these situations the quality of the screen drivers becomes evident. Some cards simply come with better drivers than others, which is especially evident in the *Windows* tests.

PRICES AND PROBLEMS

As a class, these displays are not cheap. The adapter cards often carry a megabyte or more of memory. The graphics coprocessor chips and their attendant circuitry add to both development and manufacturing costs. The fact that these systems also require custom software drivers in order to access their high-resolution modes further increases their overall cost. Finally, the monitors themselves require unusually careful construction since they must operate at high scan rates over much longer scan lines than their smaller cousins.

The combinations tested here come with retail price tags ranging from \$1,695 to \$3,495. Even the least expensive will set you back significantly more than a 13-inch monochrome VGA system.

We discovered another pair of issues that apply to these systems as a class: reliability and stability. Four monitors arrived

MONITORS

PAPER-WHITE MONITORS

dead or damaged—or died on the benches of PC Labs soon after their arrival. All of these devices rely on electron guns that are mounted in the back of rather large vacuum tubes; they operate with exacting precision. No one would be surprised that their mechanisms are a bit delicate. Still, the failure rate was startling. The lesson? Don't leave the installation of such a system to the last minute—you may need a replacement or two before you get a working model.

And, less surprisingly, the accompanying software proved to be nearly as unstable as the monitor components themselves. We became accustomed to receiving many revised drivers and updat-

ed programs during the three-week testing period. We became adept at logging onto vendors' bulletin board systems, downloading gargantuan archived files, and then decompressing them so they could be installed.

Each monitor came with its own adapter and set of drivers, which had to be installed in our test computers each time. To enable the drivers for *Microsoft Windows*, we had to reinstall *Windows* itself for each monitor. An unexpected mechanical or software-related problem meant putting the current test monitor to one side and hauling out another one. And when the

correct version of the software for the first monitor finally arrived, that meant putting away the current one and trucking the original back out once again. We found it easiest to leave all the monitors lined up along one wall, and we kept handy a fat stack of high-density floppy disks with all the different programs required for the testing procedures.

In the end, we managed to run all the monitors through their paces. As you will see, some were good and some were less than good. Perhaps the most surprising aspect of the testing process was just how quickly we became acclimated to the large screens. I, for one, became quite picky about how well I could read 10-point type

SEEING THE WHITE: Paper-White Phosphors

by Alfred Poor

Things are not always what they appear to be, and the white light from a computer screen is a perfect example. Different types of monitors produce white light in very different ways, all of which involve color.

You are probably most familiar with a typical color screen, which works in much the same way as a color television. The inside of the picture tube is coated with different phosphors, which are special chemical compounds that glow with characteristic colors when excited by a stream of electrons. In a color screen, three different colors of phosphors are used: red, green, and blue. Thanks to the additive properties of colored light, you can use combinations of these three colors to produce every shade in the rainbow. And when all three colors are mixed together in equal quantities, your eye perceives the result as white light.

This approach has its limitations. Since each type of phosphor has to be excited by electrons from a different gun than the other two, the tubes must be constructed to fine tolerances. And no matter how small the dots or how high the screen resolution, you are bound to lose a little crispness and detail at the edge of a white line where there must be a final row of one color pixel or another. This process gives the edges of images a faint color tint.

Monochrome monitors have it much easier—they use only one color phosphor and so needn't worry about such

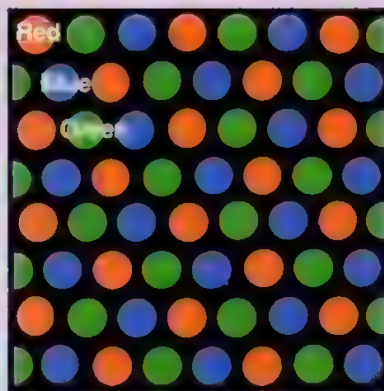


MAKING WHITE WITH PHOSPHORS

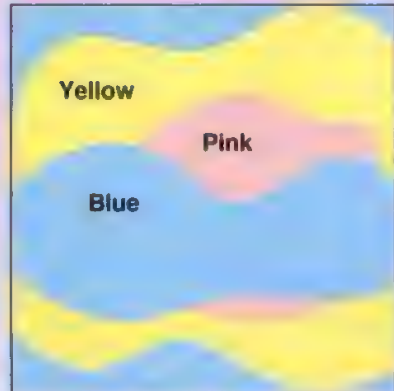
Paper-white and color monitors construct the color white in different ways. Color screens use combinations of separate red, green, and blue dots. By contrast, paper-white monitors use a solid coating of mixed

colors. This is usually a blend of yellow, light blue, and small amounts of pink to make the white look warmer. Sometimes black flecks are used to create the effect of textured paper.

Close-up of the phosphors of an RGB color monitor



Close-up of the phosphors of a paper-white monitor



precise placement of specific dots. In fact, most monochrome tubes use a uniform coating of phosphor material across the inside of the screen.

It may be surprising to discover that even these paper-white displays still rely on phosphors to produce different colors. While we tend to refer to the display as white, close inspection reveals that the images are really made up of a mixture of different colors. Most of the monitors we tested used combinations

of light blue and yellow, and some had small amounts of pink added as well.

According to one of the monitor vendors we spoke with, the tube manufacturers typically produce samples using different phosphor mixtures. Monitor OEMs then shop through these samples, picking the precise shades they want for their products. This explains why some paper-white monitors have a blue tinge while others produce a warmer tone. ■

MONITORS

PAPER-WHITE MONITORS

on a full-page *Ventura* display. The real shock didn't come until the following week when I sat in front of my trim, 13-inch color VGA display and fired up *Ventura*—I wondered where the rest of the screen had gone!

As good as some of these big screens are, perhaps we ain't seen nothin' yet. There are new products in development that will push the market and your image horizons even further. As we completed preparations for this article, a flurry of new systems were announced. None of these were ready in time for us to test them as part of this review, but they should be available by the time this issue hits the newsstands.

Flanders Research, Leading Technology, Nanao USA Corp., PixieLink, Radius, Sampo, and Sigma Designs all have new systems on the way. A Raster Technologies system was disqualified for review because it did not yet have an *AutoCAD* driver, although one is currently being developed for release.

Some of these new machines will reportedly use cards that employ an eight-plane design, providing an impressive 256 shades of gray. And the Flanders monitor will fire an awesome 300-dpi image on a 15-inch-diagonal display (and 250 dpi on a 19-inch tube). This incredible specification is made possible through 3,300- by 2,560-pixel resolution, with nearly 8.5 million pixels per screen.

So read on, if you dare. You may well end up like me: yearning to be out in those wide open spaces, rounding up *Windows* applications in vast territories with room left over, and editing your documents a full page at a time.

CORNERSTONE TECHNOLOGY

DualPage

by Alfred Poor

Cornerstone's DualPage display system is an interesting combination of old and new, and it presents you with an attractive big-screen monitor for \$3,395.

That figure may seem a little steep for a 19-inch screen, especially when most of the other systems covered in this review are priced well under \$3,000. But there are good reasons why this one costs more—16 of them, to be precise: the DualPage can display up to 16 levels of gray.

At present, the only driver that takes ad-

At \$3,395, Cornerstone Technology's DualPage is a pricey but wise way to enter the world of 16-shade gray-scale displays. This no-fuss model currently has drivers for *Ventura Publisher* only, but its 1,600 by 1,280 resolution is hard to beat.

vantage of the gray-scale feature is for *Ventura Publisher*; others are under development. If you work mostly with *Ventura*, however, you won't have to wait for new drivers to arrive. The DualPage shows its stuff best when displaying a halftone image, such as a scanned photograph, using the gray-scale driver in *Ventura*. The graphics look great, although you're not likely to mistake the screen image for the original photograph. Still, the quality is so striking that you will find the typical dithered images on most other displays unbearably coarse and ugly.

The *Ventura* driver offers another, more subtle visual advantage as well. Special screen fonts are included that use the gray-scale feature for anti-aliasing. Aliasing is the stair-step effect that you see with curved lines on computer screens—commonly described as “the jaggies.” The DualPage fonts use lighter shades of gray in pixels next to the black pixels in a curve, which help trick your eye into perceiving the combination as a smooth curve. These extra gray pixels only affected the smaller fonts on the screen, but the difference was dramatic.

In addition to the gray-scale feature, the DualPage offers one of the highest resolutions of any monitor in this group. With 1,600 by 1,280 resolution, it manages more than two million pixels. And thanks to its 67-Hz vertical scanning frequency, it can handle the image without resorting to interlacing, which can make a screen appear jittery or cause it to flicker.

With all of these pixels to be controlled,

you might expect a substantial amount of processing power on the card. As it turns out, the DualPage is among those monitors that do not use a graphics coprocessor chip on their adapters. All the same, performance does not seem to suffer much; the DualPage was among the fastest on the PC Labs video benchmark tests, and roughly in the middle of the pack on the *Microsoft Windows* and *AutoCAD* tests.

The system is fairly easy to install and set up. The 16-bit adapter card can work in an 8-bit slot if necessary, and it emulates a Hercules monochrome graphics card when it's not in its high-resolution graphics mode. This makes it practical to use the DualPage as your only monitor, since you can run your favorite applications in the Hercules mode.

Software installation is also easy. You are guided simply and clearly through the

PC FACT FILE

EDITOR'S CHOICE

DualPage

Cornerstone Technology, 1883 Ringwood Ave., San Jose, CA 95131-1721; (800) 562-2552, (408) 453-9800.

List Price: \$3,395.

Requires: IBM PC, XT, AT, or compatible; 8- or 16-bit slot.

In Short: For a gray-scale display, the DualPage is hard to beat. It offers 16 levels of gray, including anti-aliasing screen fonts for *Ventura Publisher*. It is easy to install, does not require another display adapter to run DOS applications, and delivers good performance despite its lack of a graphics coprocessor.

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US list price
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CIRCLE 241 ON READER SERVICE CARD

MONITORS

PAPER-WHITE MONITORS

process by on-screen prompts and instructions. Not all of the steps can be handled through the installation program, but it tells you what to do to finish the task after it has done its job. The installation program also uses a nice *Windows/286* feature that lets you use a different driver disk during the setup procedure; this saves you from having to make an extra backup copy before you install *Windows*.

Cornerstone has produced an excellent display, especially in light of the Dual-Page's gray-scale and anti-aliasing *Ventura* fonts. It offers acceptable benchmark test scores, crisp images and text, and easy configuration, and it does not require a second adapter card and monitor for most applications. All this is wrapped up with a price tag that is hardly bargain-basement but does represent a good value for a 16-level gray-scale system. If you're shopping for a large gray-scale display, this monitor is the best of the bunch.

ELITE BUSINESS APPLICATIONS INC.

DesignView/19

by Alfred Poor

Elite Business Applications' DesignView/19 is remarkable for its low list price of \$1,695—the lowest price in our review group. Yet despite its low price, the DesignView/19 offers a full 1,280 by 1,024 resolution and an Intel 82786 graphics coprocessor. The big question is whether this monitor can deliver on its promise of high performance at low cost.

As soon as you unpack the components you'll notice one major difference between this and the other adapters: the DesignView/19 adapter card uses only an 8-bit connector. This means that the full-length card can go in almost any free slot in your computer. And the adapter worked fine with its remarkably few on-board jumpers in their factory-default settings, making the installation virtually painless.

The software installation was also fairly easy, though not as simple as for other monitors. All the drivers came on a single high-density floppy disk. There was no central installation utility, but the DesignView manual and the README files did an adequate job of pointing the way.

Images produced using the custom drivers were generally good, though the results were not consistent. As you should

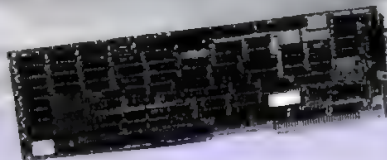
expect at this price, the system produces only black-and-white displays—no gray scales. Still, the higher-than-average resolution yielded excellent images in *Microsoft Windows*, and the body text in *Page-Maker* was clearly legible even on a two-page display. *Ventura Publisher*, however, did not fare quite as well. The scroll and menu bars looked disproportionately wide, and the body text was only fair in a full-page display.

The DesignView/19 does have some more-significant flaws. The manual is a bit thin, and some of the information it contains is wrong. For example, the manual discusses a bus-mouse port, but this was not present on the card that came with the system. According to an Elite Business Applications representative, the port had been included in earlier versions of the adapter but is not available now. The company is planning to implement the port again but is not definite about when.

The system also turned in some discouraging benchmark test times. It fared best in selected *Windows* tests, perhaps because the driver makes use of the primitive commands built into the 82786 graphics coprocessor chip. It placed smack in the middle of the results for *AutoCAD* but came in dead last on the DOS display tests.

Then there is the problem of applications without drivers. Many competitors have chosen to solve this problem by building in a standard emulation, and this system follows the same general strategy. But while the others make use of their high-resolution displays by emulating

Elite Business Applications sells its DesignView/19 for the low, low price of \$1,695, and the monitor's performance suffers commensurately. It does boast a graphics coprocessor and a respectable 1,280 by 1,024 resolution.



VGA or monochrome Hercules adapters, the DesignView/19 takes a surprising low-road approach and emulates CGA! The coarse, ugly characters are even more offensive when blown up to a huge size on the 19-inch screen.

Fortunately, Elite Business Applications has a replacement in the works. The DesignView/19e is reported to have a 16-bit card, Hercules emulation, and more drivers. As a result, this newer system should prove to be more attractive and give better performance than the company's current offering.

Although the DesignView/19 comes at an alluring price, you will find that a little more money will buy you better results elsewhere. This is one case where the best price does not mark the best bargain.



FACT FILE

DesignView/19

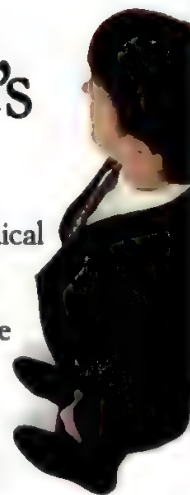
Elite Business Applications Inc., 36D Rt. 3 North, Millersville, MD 21108; (800) 942-0018, (301) 987-9050.

List Price: \$1,695.

Requires: IBM PC, XT, AT, or compatible; high-density 5.25-inch floppy disk drive; 8- or 16-bit slot.

In Short: The DesignView/19 has a graphics coprocessor, more pixels than average, and the best price in the field. It also has only an 8-bit connector on its adapter, average-to-low benchmark test scores, mixed-quality drivers, and an incredibly low-resolution CGA emulation mode for regular applications. In spite of the low price, better buys are available.

CIRCLE 420 ON READER SERVICE CARD



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PERFORMANCE TESTS: PAPER-WHITE MONITORS

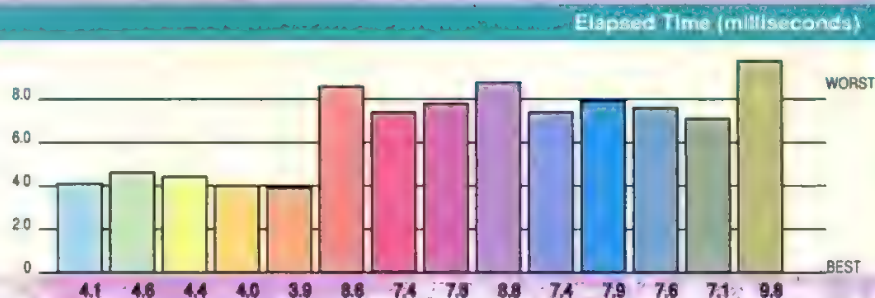
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MICROSOFT WINDOWS PERFORMANCE TESTS

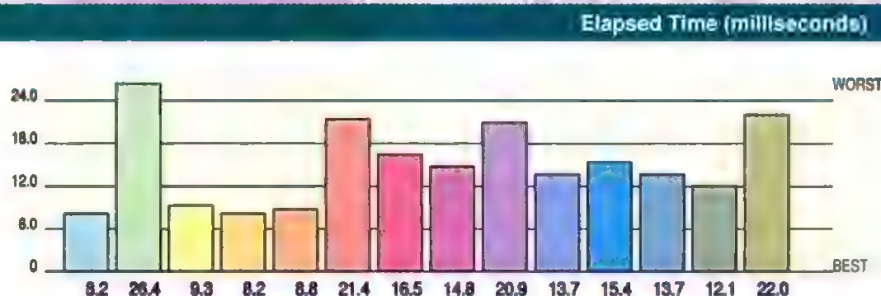
Line Two

The **Line Two** function test measures the time it takes to draw 100 random lines of various colors.



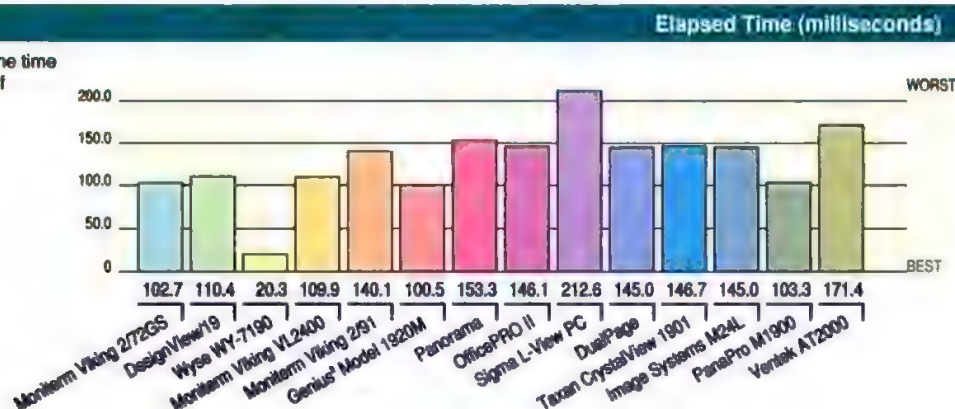
Rectangles

The **Rectangles** test measures the time it takes to draw ten rectangles of random size and color.



Ellipses

The **Ellipses** test measures the time it takes to draw 100 ellipses of random size and color.



CONTINUES

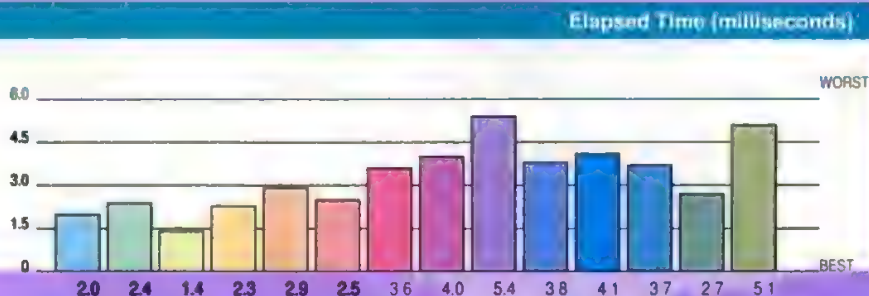
MONITORS

PAPER-WHITE MONITORS

PERFORMANCE TESTS: PAPER-WHITE MONITORS

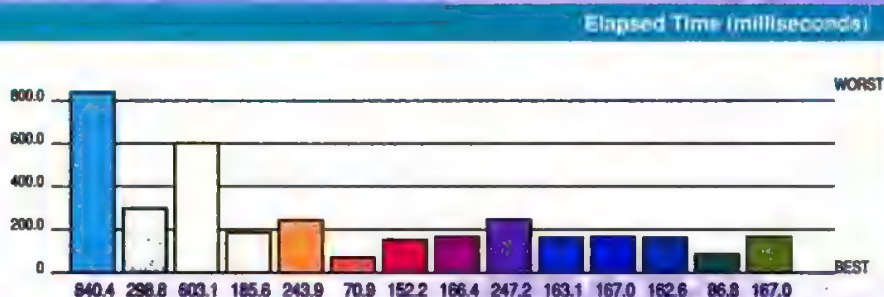
Bitblt

The **Bitblt** (Bit Block Transfer) test measures the time it takes to draw 100 rectangles of the same size and color.



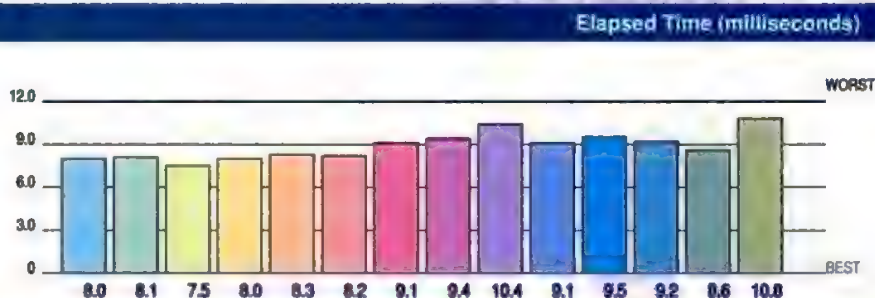
Stretchblt

The **Stretchblt** (Stretch Block Transfer) test measures the time it takes to draw 100 copies of a rectangle with varying sizes but the same color.



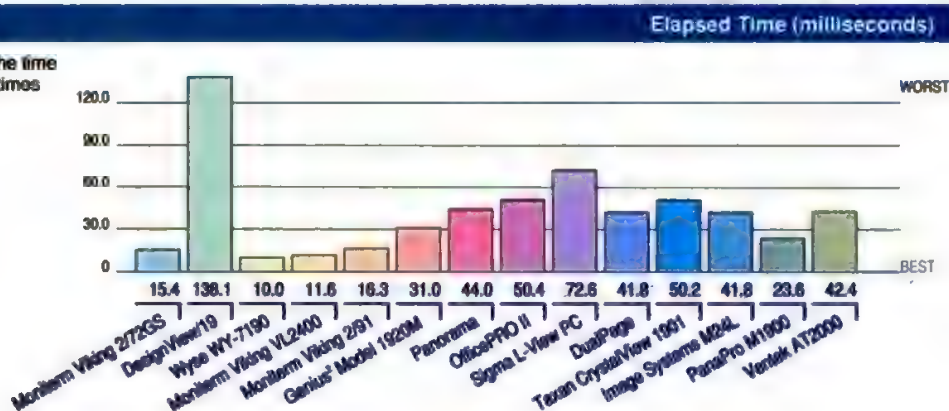
Scrollwindow

The **Scrollwindow** test creates a rectangle one-tenth the height and one-tenth the width of the window—in the upper-left-hand corner of the window—and measures the time it takes to scroll the rectangle across the window to the right, down, and diagonally back to the upper left of the window, pixel by pixel.



Fill Rect

The **Fill Rect** test measures the time it takes to fill the window 512 times with varying colors.



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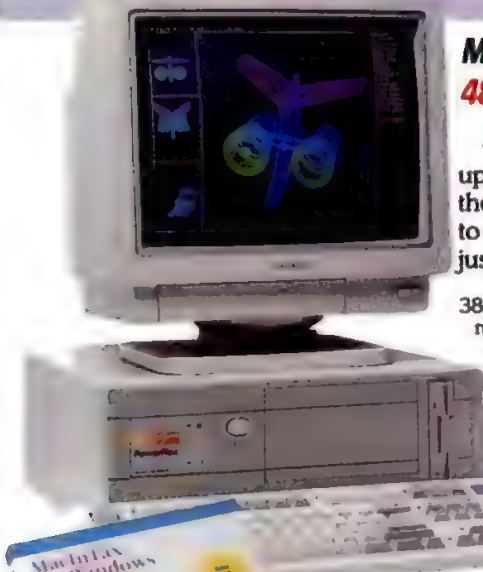
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(Xerox)

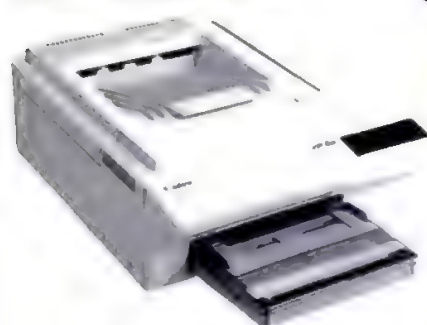
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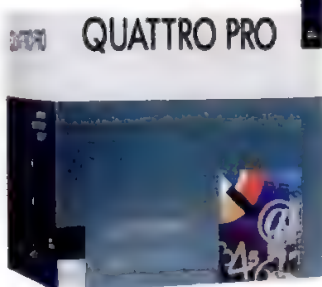
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Teacher in a Box-Lotus 3.0 L.1	62.
Teacher in a Box-WrdPct 5.0 L.2 ..	56.

CAD SOFTWARE

American Small Business Co.	
Design CAD 3.1	143.
Design CAD 3D 2.1	205.
Drafix	
Windows CAD	429.
Generic Software	
Basic Home Design	29.
Generic CAD 3D Drafting	132.
Generic CAD Level 3 w/ Dot Plot ..	145.
MathSoft	
MathCAD 2.5	285.

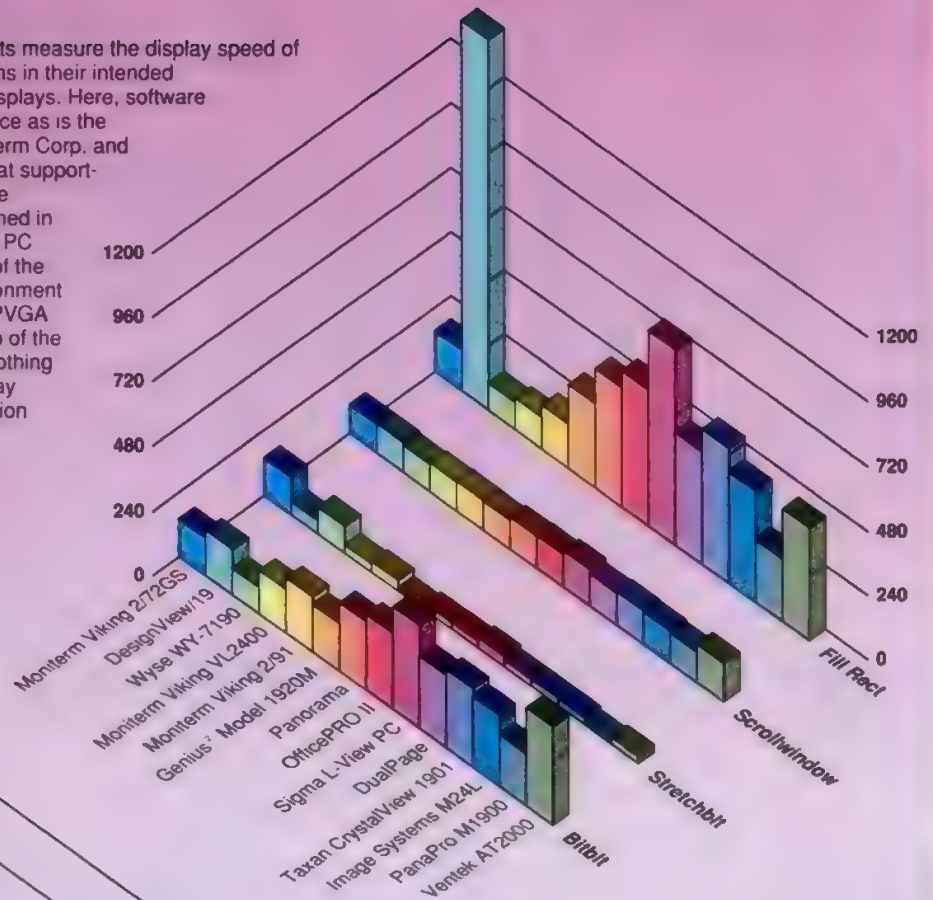
MEDIA & ACCESSORIES

Allsup	
Cleaning Kit for 3 1/2" system	13.
Cleaning Kit for 5 1/4" system	11.
American Covers	
Mouse Mats	7.
BASF Disks (box of 10)	
5 1/4" DS/DD (360k)	10.
Curtis	
Anti-Glare Glass Filter/S	Call.
Computer Starter Kit	34.
Ruby Plus w/Fax & Modem	66.
Universal Printer Stand	17.
Universal System Stand	22.
Kensington	
Masterpiece Plus	95.
Maxell Disks (box of 10)	
3 1/2" DS/HD (1.44Mb)	34.
Safe Power Systems	
Safe 425W Standby Power BU	363.
Sony (box of 10)	
3 1/2" DS/HD (1.44Mb)	32.
Targus	
Premier Leather Case	189.
Nylon Carrying Case	54.

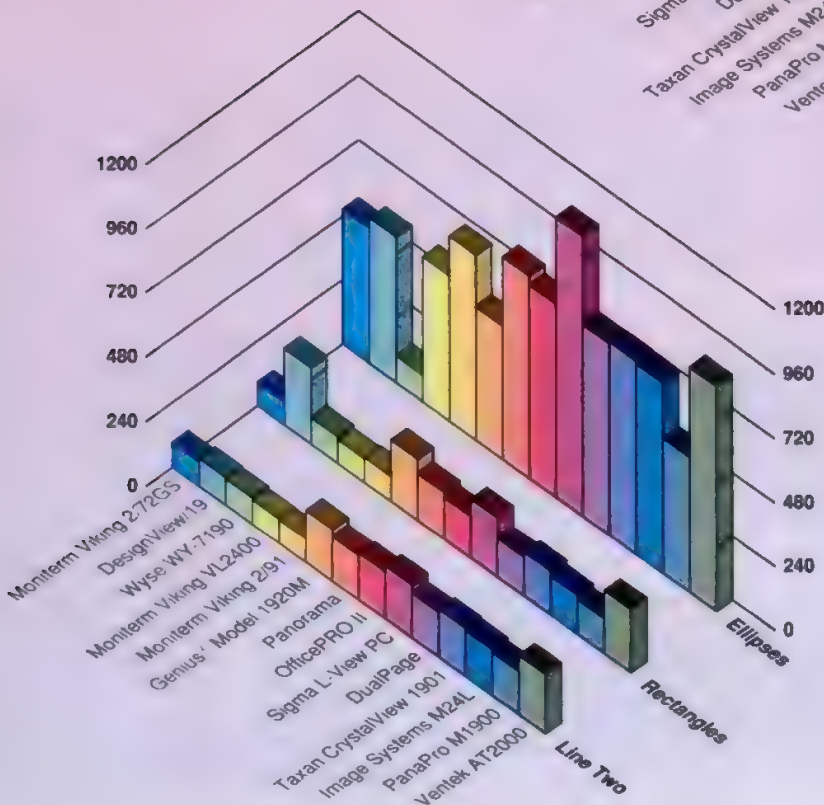


PERFORMANCE TESTS: COMPOSITE VIEW

The *Microsoft Windows* performance tests measure the display speed of these high-resolution paper-white systems in their intended environment: high-resolution graphics displays. Here, software support is just as important to performance as is the hardware that it's running on. The Monterm Corp. and Wyse Technology systems are the best at supporting the *Windows* environment. In fact, the systems from these two companies finished in top positions in virtually every one of the PC Labs *Windows* performance tests. One of the slower boards under the *Windows* environment was the Ventek AT2000. The Paradise PVGA controller chip, which hoisted it to the top of the PC Labs video benchmark tests, does nothing to enhance the performance of the display adapter when running in the high-resolution mode of *Windows*.



Relative Times
(Wyse WY-7190 = 100)



ENDS

You are surrounded by a bunch of losers.



"Uh, my system crashed and my file disappeared."



"Have you ever had one of those days?"



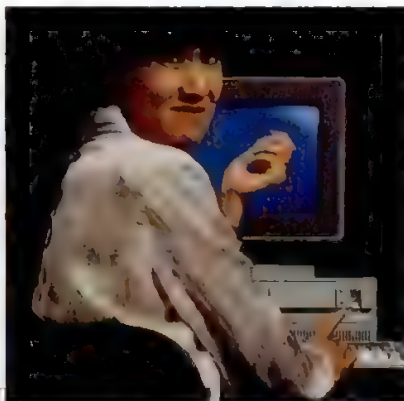
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MONITORS

PAPER-WHITE MONITORS

IMAGE SYSTEMS CORP.

Image Systems M24L

by Alfred Poor

Can you guess what the "24" stands for in the Image Systems M24L model number? If you said "24 inches" you can leave class early today. Sure, this baby is priced at \$3,495—which makes it the most expensive system tested here—but you can rest assured that for this price you also get the largest system in the pack.

Not that biggest is always easiest, however. First, you install the monitor on its separate tilt-and-swivel base; next, you need to find a good spot that will hold the 60-pound assembly. The cable was a mere 5 feet long—a full foot shorter than most competitors—so that good spot may have to be a little closer to your PC than you'd be putting certain others.

Logistics aside, the best feature of the M24L is its controller. Made by Cornerstone, it is almost identical to the one used in the DualPage reviewed earlier in this roundup. It is a four-plane card that provides 16 shades of gray. The drivers include gray-scale support for *Ventura Publisher*, as well as anti-aliasing fonts similar to those included with the DualPage.

The 16-bit card is a snap to install, and it can operate in an 8-bit slot if necessary. It emulates a Hercules monochrome display in the absence of a custom driver, making it comfortable to use with regular DOS applications. The drivers come with a simple installation program that automates as many steps as it can—and prompts you on-

screen with information needed to complete the configuration for various supported applications.

Image Systems does its best to let you optimize the display; the M24L is one of the few monitors that brings most of the controls out through the case so you can adjust them. You can fiddle with horizontal and vertical size and position.

And since it has the same 1,600 by 1,280 resolution as the DualPage, you might expect great things from the M24L; after all, it does have a bigger screen. Unfortunately, I could not get the M24L to produce the great picture I expected, no matter how much I worked on the controls. Wavy edges were manifest near the top and bottom corners on both sides of the screen, deforming the image near these areas. According to an Image Systems Corp. representative, this was not an unusual occurrence. He ascribed it to difficulties in tuning the tube's electron gun so that it would create an even display.

But even in the middle of the screen, the image suffered. Yes, the *Ventura* driver supported gray-scale imaging, but the anti-aliasing fonts came out muddy instead of giving the sharp image produced on the DualPage. According to the representative, Image Systems is developing a *Windows* driver that will add gray-scale support. This can only help.

Perhaps the most disconcerting problem was the pronounced image-bounce caused by mode changes, such as those between DOS and *Windows*.

The M24L is simply not a hit. For now,



FACT FILE

Image Systems M24L

Image Systems Corp., 11543 K-Tel Dr., Hopkins, MN 55343; (800) 462-4370, (612) 935-1171.

List Price: \$3,495.

Requires: IBM PC, XT, AT, PS/2 Model 30, or compatible.

In Short: The M24L uses a good display card and drivers but cannot hold the line at high resolutions to deliver a top-quality image. Besides being the largest and heaviest in this collection, it is also the most expensive. It is the only competitor to offer both a 24-inch screen and 16-level gray-scale support, but most systems that offer either one of these features will represent a better value.

CIRCLE 421 ON READER SERVICE CARD

it's just too big, too fuzzy, and too expensive. This is the only choice here for both a 24-inch screen and a 16-level gray scale, but if you can settle for one or the other, your CAD or DTP needs are better served by making a different choice.

MICRO DISPLAY SYSTEMS INC.

Genius² Model 1920M

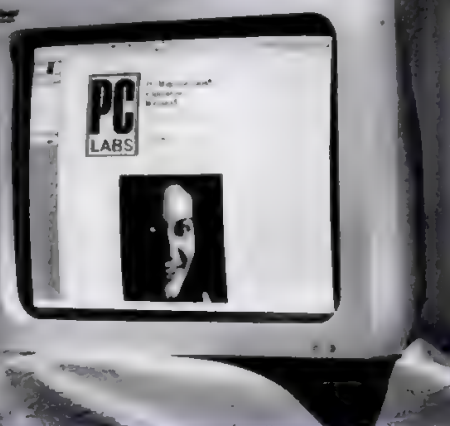
by Kellyn S. Betts

Let's face it: our experiences with the \$1,995 Genius² Model 1920M were not wonderful. Whether the system's problems are irremediable remains to be seen.

The first monitor (shipped by UPS on the ground, as are all the monitors the company sells) arrived dead. The second one we received worked, but its manual was somewhat out of date and it came without the TIGA drivers we needed to perform our tests. These were readily available through the company's bulletin board, but the board's existence wasn't mentioned in any of the literature packaged with the product.

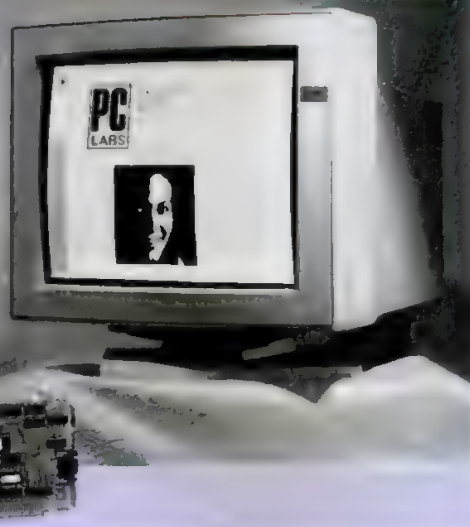
Once they arrived, the TIGA drivers proved difficult to use because they require you to change the jumper-shunt settings on the jumper- and wire-ridden board. (In fact, since you need to reset the shunts and change your CONFIG.SYS file to use the TIGA driver for *AutoCAD*, for all practical purposes you have to dedicate the product to that application.) The *Microsoft Windows* and *GEM* drivers, which both require the same jumper-shunt setting, worked well and filled the screen nicely once we set up the batch files that were required to load the TIGA software. Eventu-

The Image Systems M24L seems to have it all, from 16-shade gray scale and a 24-inch screen to a hefty list price of \$3,495. This model is the largest system reviewed here, but it doesn't always live up to its promise.



MONITORS
PAPER-WHITE MONITORS

Micro Display Systems' Genius² Model 1920M has an affordable cost of \$1,995 but not much else to recommend it. Its haphazard design causes difficulties that make it a less than propitious choice.



ally, all the drivers did work.

To describe the large and reasonably priced offering from Micro Display Systems as high-resolution would be deceptive. What appears to be an impressive monitor/adapter combination ultimately delivers far less than expected in terms of both features and performance.

After you open up the carton containing the monitor and adapter and read the manual describing them, you believe you have a 19-inch monitor with a 16-bit adapter graced with a TI 34010 chip that displays four levels of gray scale and supports a lot of software. The adapter may look as if it has a 16-bit interface, but it's really only 8-bit—a fact that the manufacturer admits but refuses to explain. The manual that comes with the system claims that it supports four levels of gray scale, but although its creators initially hoped to provide this, they were unable to do so,

because DRAM prices were high when the product was created.

Finally, the manual boasts that the monitor and adapter support a large number of applications, but only three software drivers are optimized to work with the TI 34010 chip: *Windows/286*, Versions 2.0 and 2.1, *GEM*, Version 3.0, and (according to our contacts at MDSI), *AutoCAD*, Version 9. But we couldn't get the last-mentioned software to work. Some of the other drivers didn't work at the high 1,280 by 1,024 resolution or didn't take complete advantage of the screen.

The Genius² is disappointing in its performance as well. Running under the applications optimized for its use, its benchmark test results were middle-of-the-road, and in many cases the adapter did not perform as well as those without TI 34010 coprocessors. Also, though the monitor's resolution is extremely high, it doesn't display high-resolution characters as well as you'd expect under *Windows* or *GEM*: characters look small and washed out compared with those of competing models. In the brightly lit environment of PC Labs, it was often hard to read text on the monitor screen.

Micro Display Systems' saving grace is its excellent technical support staff. Unfortunately, even those dedicated workers can't make you forget that the product they're helping you use has some serious limitations. We hear that MDSI has a new paper-white monitor in development. Our advice? Wait for its introduction—or choose something else.

MONITERM CORP.

Moniterm Viking 2/72GS

by Alfred Poor

With a list price of \$2,695, the Moniterm Viking 2/72GS costs less than the other two 16-level-gray-scale systems tested here. This paper-white system is a perfect example of the bargain trade-off dilemma: do you save some money and swallow a few design quirks, or spend more for a flawless system? The Moniterm doesn't make this debate any simpler.

To start with, the 2/72GS does not skimp on components. The adapter board sports a Hitachi HD63484 graphics coprocessor chip, and this brains-on-board is backed up by a whopping 4MB of VRAM.

The system also comes with a large set of driver disks. Moniterm was one of the moving targets in this review; we received an updated set of drivers for the monitor a few days after we started testing. The 2/72GS has gray-scale support for *Ventura Publisher* and is one of the few systems that also has a gray-scale driver for *Microsoft Windows*. Unfortunately, not many *Windows* applications support gray scale (and *PageMaker* is one of the many that do not), so Moniterm included a demo version of its *Image-In* program, which allows you to do a great deal of image editing under *Windows*. The program handles scanning and OCR tasks as well.

The 2/72GS has another impressive feature in its drivers. The board is able to create an image far larger than will fit on the screen, so you can create a virtual display and view a portion of the total display, then scroll to see the other areas. This



FACT FILE

Genius² Model 1920M

Micro Display Systems Inc., P.O. Box 455, 755 31st St. East, Hastings, MN 55033; (800) 328-9524, (612) 437-2233.

List Price: \$1,995.

Requires: IBM PC, XT, AT, or compatible; 8-bit slot.

In Short: This high-resolution display system has an impressive list of features, but ultimately it doesn't live up to its potential. With the wide choice currently available, there's no reason to settle for a problematic display system.

CIRCLE 422 ON READER SERVICE CARD



FACT FILE

Moniterm Viking 2/72GS

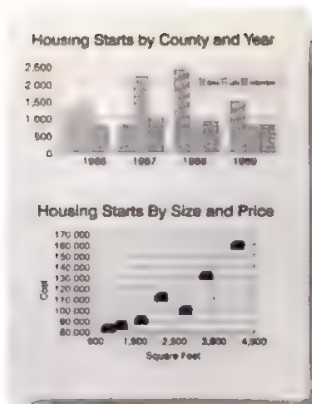
Moniterm Corp., 5740 Green Circle Dr., Minnetonka, MN 55343; (800) 343-4969, (612) 935-4151.

List Price: \$2,695.

Requires: IBM PC, XT, AT, or compatible; additional standard adapter card and monitor; 8- or 16-bit slot.

In Short: The Moniterm Viking 2/72GS is the lowest-priced 16-level-gray-scale unit in this group, but it is difficult to install, remains picky about your configuration, and does not produce as good an image as its two direct competitors (with somewhat higher price tags).

CIRCLE 423 ON READER SERVICE CARD



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(PostScript device)

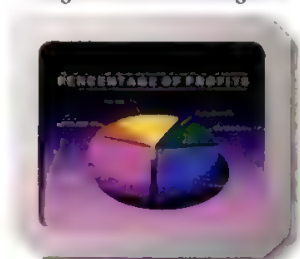


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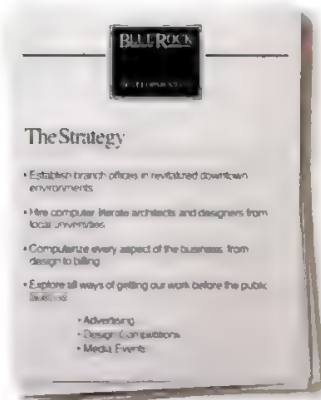
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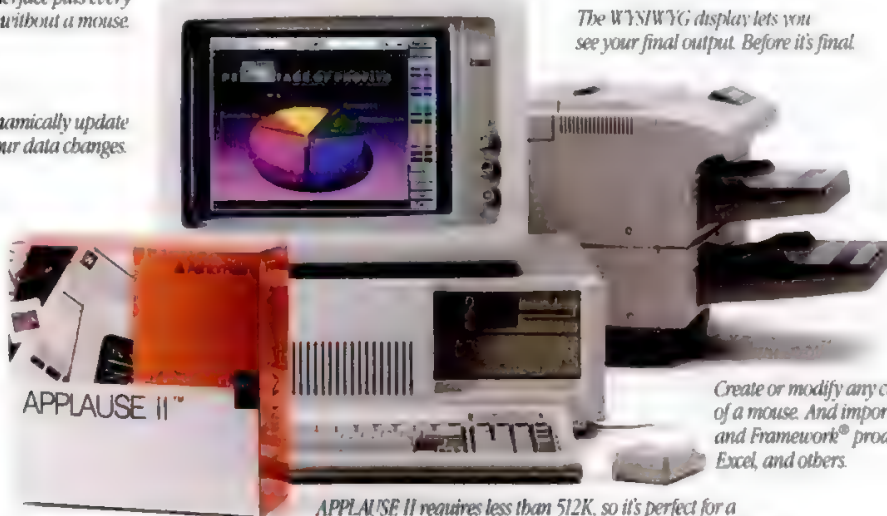
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of fonts, color, and rotation. (HP LaserJet)

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MONITORS

PAPER-WHITE MONITORS

method is faster than the scrolling built into *Windows* or *Ventura*.

Despite its impressive hardware and software features, the 2/72GS falls short of the mark, exhibiting flaws in a number of important areas.

One of those flaws is the quality of text display under the special drivers. Neither the *Windows* nor the *Ventura* images were very clear. You need to create and install Bitstream screen fonts (which Monitorm bundles with the system) to get good displays. These are much better, but they require more work on your part than with other systems where these screen fonts are already provided for you.

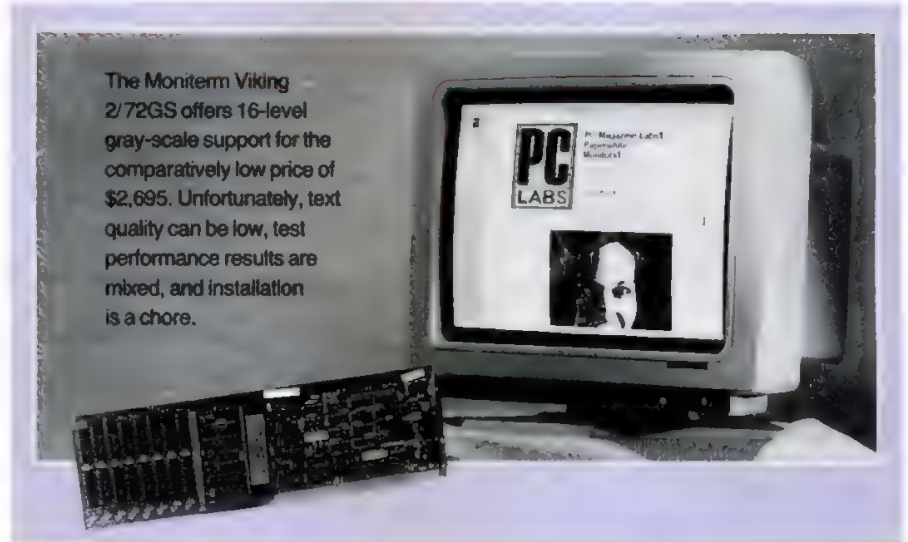
The application drivers do come with a centralized installation program, but it is not as elegant as some of the others. For example, the Monitorm installation process requires that you modify a backup copy of your *Windows/286* install disk rather than letting you use the facility that lets *Windows'* SETUP read a driver from a

The Monitorm Viking 2/72GS offers 16-level gray-scale support for the comparatively low price of \$2,695. Unfortunately, text quality can be low, test performance results are mixed, and installation is a chore.

separate disk.

Hardware installation is yet more work. The adapter card can be used in a system

without a second video adapter and monitor already installed, but this is tricky since nothing appears on the 2/72GS's screen



BRAINS ON BOARD: The Role of Graphics Coprocessors

by Alfred Poor

Pity the poor high-resolution display adapter: it has between one and two million pixels to keep track of, yet users expect it to do its job so quickly that they won't even be aware of its presence. And when you consider the trend toward support for 16 levels of gray or more, the amount of information per pixel is multiplied at least four times.

Sure, you can pawn off the task onto your PC's CPU, but even the multi-MIPS processors found in top-end machines can show signs of strain when keeping track of the display. To solve this problem, many board designers have resorted to the use of graphics coprocessors. Surprisingly, perhaps, there are vast differences among the major players, and their effects on performance vary to a startling degree.

As demonstrated by the systems that are discussed in these reviews, three chips are most popular: the Intel 82786, the Hitachi HD63484, and the Texas Instruments 34010. Each chip has its own special strengths and weaknesses that make it best suited for particular tasks. In fact, Number Nine Computer Corp. makes a number of specialized high-resolution boards that each rely on two different graphics coprocessors to

handle different tasks.

The Hitachi and Intel chips are most similar. Both have limited intelligence and are "hard-wired" to perform certain functions, in much the same way as a pocket-calculator chip knows only how to add, subtract, multiply, and divide. In the case of the graphics chips, each knows how to handle specific graphics operations.

The Intel 82786 has a feature that makes it especially attractive for some display designers. It can build a bitmap for an image larger than the screen and then display any section of that image. Perhaps the biggest advantage of this feature is scrolling speed; rather than having to recreate the entire image each time, the chip can be directed to look at another portion of the image in memory and display it on the screen.

The TI 34010 takes a very different approach. Much like a PC's CPU, it knows only the most rudimentary functions and derives its power from the fact that it can be programmed to perform different functions. This design gives it incredible flexibility. And while the Hitachi and Intel chips must take their instructions one at a time, you can download a program to the TI 34010, which will execute the program by itself, leav-

ing the CPU with more free time to do its own work.

Does all this power mean better performance? The answer is a definite maybe. As with so many hardware features, the final performance often depends a great deal on the software in use and the task being performed. A poorly written driver can negate the benefits of a coprocessor.

The results from the PC Labs benchmark tests were mixed. The Hitachi-based Monitorm controllers did the best job with two of the *Windows* speed tests: Lines and Rectangles. The 34010-based Wyse came out on top on most of the other *Windows* tests, but the Micro Display that uses the same chip did not do as well. And all the boards with coprocessors were slower on the DOS display tests than their competitors without coprocessors.

If there is a generalization to draw from the evidence, it's that you will get added performance from a graphics coprocessor on your display adapter only if you are using a specialized driver that can take advantage of it. The quality of the driver directly affects the potential benefit, so in the end you must look beyond the design of the display adapter and consider the system as a whole. ■

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PC MAGAZINE, SEPTEMBER 12, 1989

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DESIGN NEWS, MARCH 27, 1989:

"PS4 is a thorough and complete management system. Its built-in flexibility and abundant features allow for efficient planning of even the most complex projects."

DANIEL YAHDAV, PM SOLUTIONS, JUNE 1989:

"Project Scheduler 4 earns PM Solutions' highest marks in ease of use. It leads its competition in schedule recalculation and resource leveling performance."

PC MAGAZINE, SEPTEMBER 12, 1989:

"Context-sensitive help and three levels of automatic prompting offer enough assistance that you may never open the fine manual that accompanies the program."

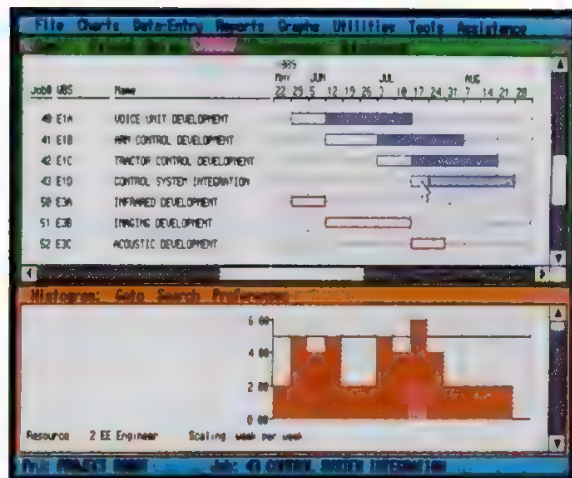
"Project Scheduler 4's project management graphs and charts are simply the best around."

"With good scheduling facilities, excellent graphics, and the best interface in its class, the program is well on its way to becoming the premier project manager."

INFO WORLD, SEPTEMBER 25, 1989:

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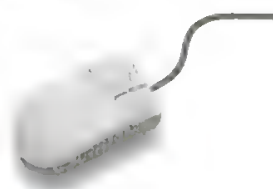
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MONITORS

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PERFORMANCE TESTS: PAPER-WHITE MONITORS

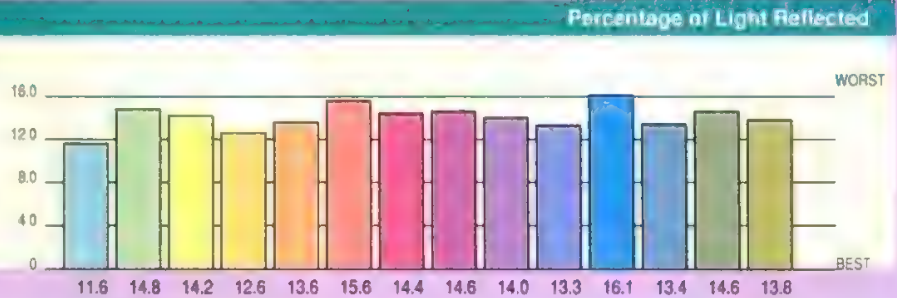
Monitorm monitors are built to resist the higher glare that these oversize screens tend to produce. Monitorm

achieves this effect by combining a darker screen coating with a matte finish on the monitor tube.

MONITOR GLARE TESTS

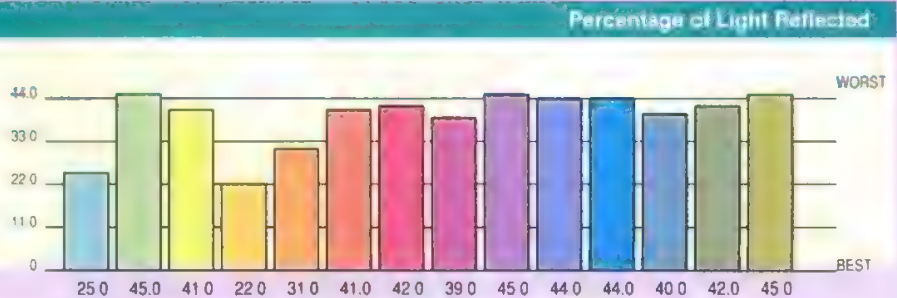
Zero Distance

To measure monitor surface reflectivity, the **Zero Distance** test takes a reading of reflected light using a reflecting densitometer placed directly on the screen surface. The results are indicative of the screen's reflectivity when the effects of screen curvature are eliminated. A lower score indicates that less light is reflected from the screen's surface.



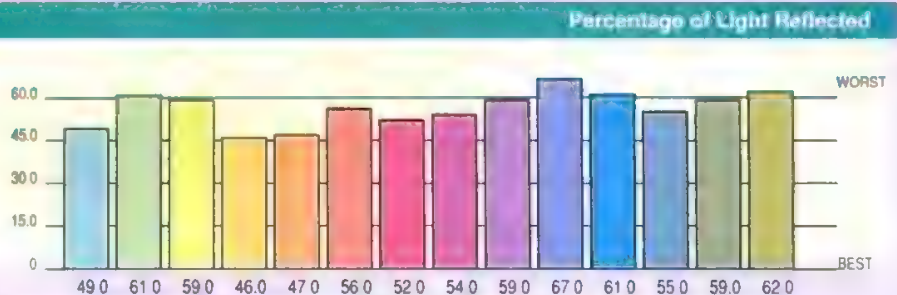
30 Degrees

The **30 Degrees** test places a diffused spotlight at a 30-degree angle to the monitor screen to simulate the glare from office ceiling lamps. The percentage of the original light energy that bounces back off the screen is measured with a spot meter. Lower readings indicate less monitor glare.



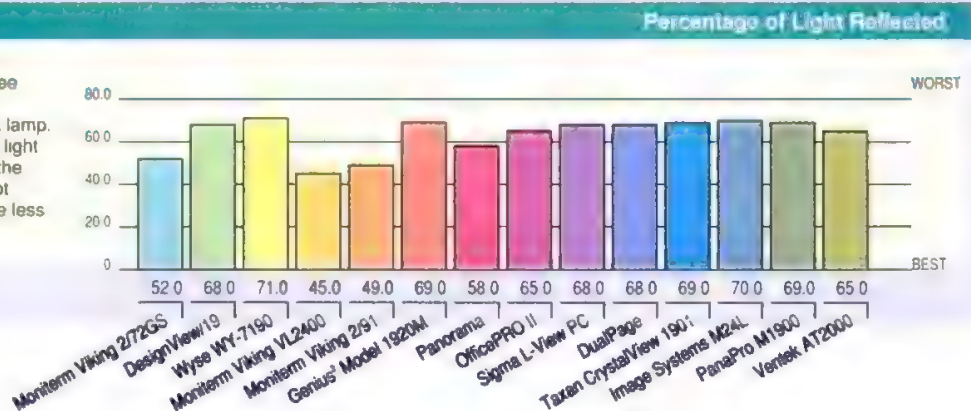
45 Degrees

The **45 Degrees** test places a diffused spotlight at a 45-degree angle to the monitor screen to simulate the glare from a desk lamp. The percentage of the original light energy that bounces back off the screen is measured with a spot meter. Lower readings indicate less monitor glare.



60 Degrees

The **60 Degrees** test places a diffused spotlight at a 60-degree angle to the monitor screen to simulate the glare from a desk lamp. The percentage of the original light energy that bounces back off the screen is measured with a spot meter. Lower readings indicate less monitor glare.



CONTINUES

MONITORS

PAPER-WHITE MONITORS

until you load a video BIOS program. The card does not emulate a standard display without that video BIOS. As a result, you will want to keep a second monitor and adapter installed in your system. Complicating the problem of maintaining a second monitor is the 2/72GS's short cable—about 4 feet long—which limits how far you can move the monitor. If you use your regular monitor to handle the SETUP, make sure it has a cable long enough to accommodate the 2/72GS.

In terms of performance, the 2/72GS presented confusing results: it was one of the fastest in the *Windows* tests, but next to

last in the *AutoCAD* measurement. It didn't score at all on the DOS tests because there was no way to make it take priority over the other installed display, and the benchmark tests would not run if the other card was not present.

The Viking 2/72GS is appealing on its own, but the display quality and ease of installation can't compare with some others. It is an acceptable selection if you need 16-level gray scale and want to pay as little as possible, but if you can spend a little more, look further.

MONITERM CORP.

Moniterm Viking 2/91 and Viking 2400

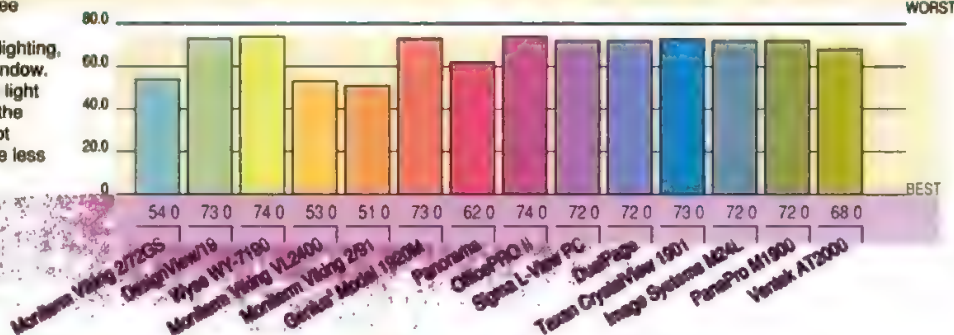
by Alfred Poor

The Moniterm Viking 2/91 and Viking 2400 display systems present you with a simple choice: big or really big. The 2/91 has a 19-inch-diagonal screen and a \$2,195 list price, while the 2400 is a 24-inch model listing for \$2,795. These are the most expensive strictly black-and-

PERFORMANCE TESTS: PAPER-WHITE MONITORS

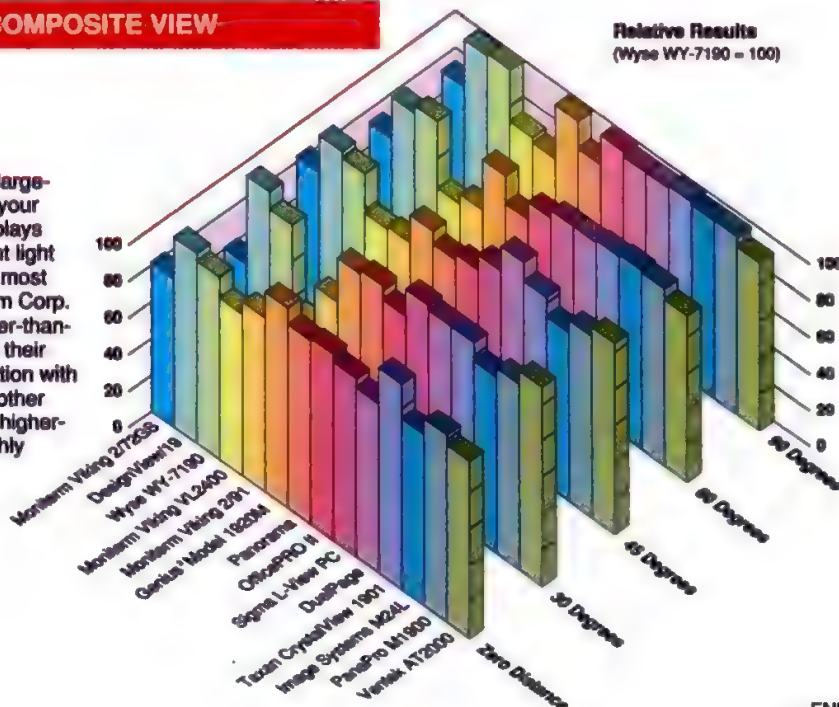
90 Degrees

The 90 Degrees test places a diffused spotlight at a 90-degree angle to the monitor screen to simulate the glare from direct lighting, such as that coming from a window. The percentage of the original light energy that bounces back off the screen is measured with a spot meter. Lower readings indicate less monitor glare.



MONITOR GLARE TESTS: COMPOSITE VIEW

Resistance to glare is particularly important to large-screen monitors. With more surface area than your standard PC display, these high-resolution displays have the potential to reflect more of the ambient light found in typical office environments. The three most glare-resistant monitors were from the Moniterm Corp. family. All the Moniterm monitors exhibited lower-than-average glare readings because the surface of their tubes is covered with a matte finish in combination with a darker-than-average screen coating. On the other end of the scale, the Wyse WY-7190 turned in higher-than-average glare readings because of its highly reflective screen glass.



ENDS

MONITORS

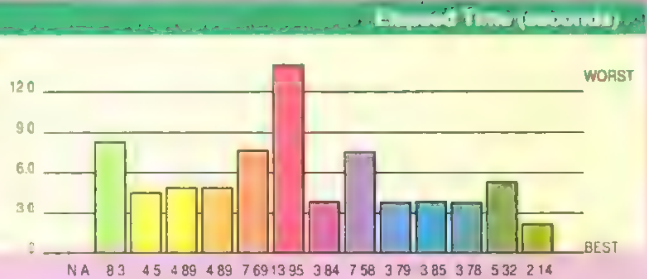
PAPER-WHITE MONITORS

BENCHMARK TESTS: PAPER-WHITE MONITORS

The Ventek AT2000 monitor-and-adaptor combination sailed past its competitors by providing a higher level of VGA compatibility. Display systems using the Cornerstone display controller—with its Hercules compatibility—were close behind.

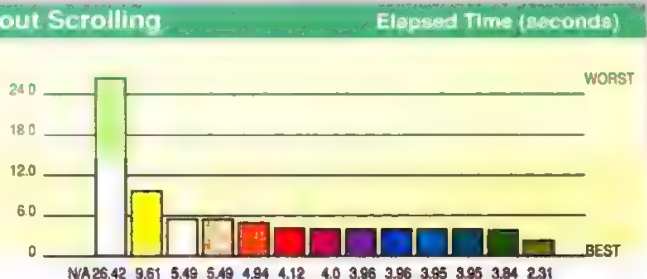
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



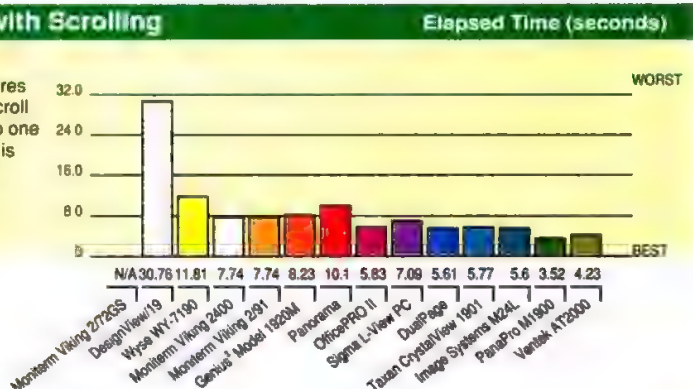
Video BIOS Routine Without Scrolling

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the video adapter BIOS writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



Video BIOS Routine with Scrolling

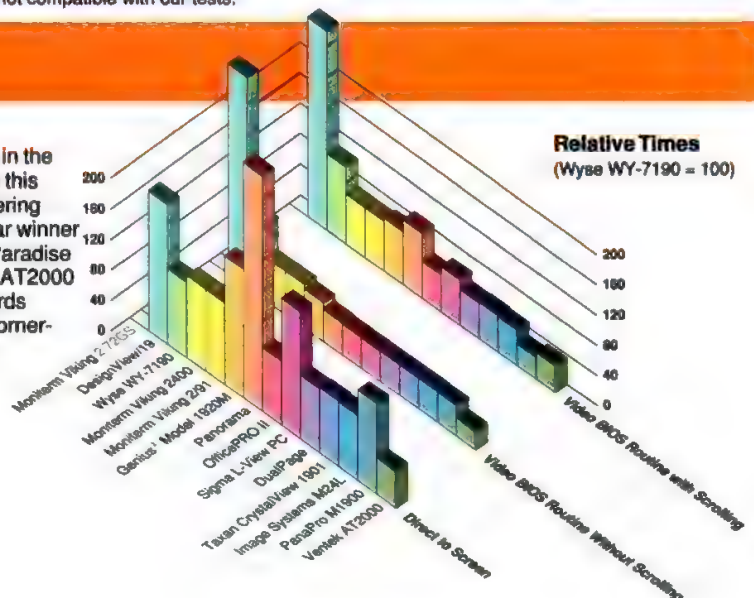
The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



N/A—Not applicable: this monitor's passthrough was not compatible with our tests.

VIDEO BENCHMARK TESTS: COMPOSITE VIEW

The PC Labs video benchmark tests showed a wide variation in the performances of the paper-white display adapters reviewed in this roundup. This disparity was caused mainly by the boards' differing compatibility levels, which ranged from MDA to VGA. The clear winner is the Ventek AT2000. Its VGA compatibility, handled by the Paradise PVGA chip set running through a 16-bit interface, allowed the AT2000 to outpace its competition. Close behind were the display boards accompanying the Panasonic, Image Systems, Taxan, and Cornerstone Technology (Dual Page) Systems. All of these systems use a Cornerstone display controller to permit Hercules display compatibility. No results are displayed for the Monterm Viking 2/72GS because its CGA passthrough was incompatible with our tests.



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VIEW FILES	✓	✓	✓	✓
OPEN/ASSOCIATE APPLICATION	✓	✓	✓	✓
SPLIT WINDOWS	✓	✓	✓	✓
PRUNE/GRAFT	✓	✓	✓	✓
GLOBAL FILE VIEWS	✓	✓	✓	✓
COLLAPSE DIRECTORIES	✓	✓	✓	✓
HIDE/UNHIDE DIRECTORIES	✓	✓	✓	✓
FORMAT DISKS	✓	✓	✓	✓
TOGGLE/MERGE TAGGED FILES	✓	✓	✓	✓
REVERSE FILE SPECS	✓	✓	✓	✓
COPY ORIGINAL DIRECTORY STRUCTURE	✓	✓	✓	✓
DATE/TIME STAMP FILES	✓	✓	✓	✓
PRINT DIRECTORY TREE	✓	✓	✓	✓
CHANGE FILE ATTRIBUTES	✓	✓	✓	✓
RENAME A VOLUME	✓	✓	✓	✓
ARCHIVE MANAGER	✓	✓	✓	✓
EGA/VGA SUPPORT	✓	✓	✓	✓
MOUSE SUPPORT	✓	✓	✓	✓

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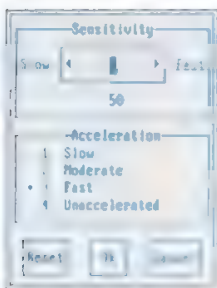
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MONITORS

PAPER-WHITE MONITORS

white displays—no gray-scale support—in the bunch, but not without some justification.

Both systems use the same adapter card, which plays a major part in determining performance. The adapter card has a 16-bit edge connector, though it can be set up to run in an 8-bit slot if need be. The board has 2MB of RAM that supports a Hitachi HD63484 graphics coprocessor.

The card also requires that another display card be installed in your system—either a monochrome, Hercules, or CGA adapter. You can leave a second monitor attached to this standard display adapter, or you can use a short cable supplied by Monterm to pass the signal directly into the Viking adapter. It then displays the image on the large screen.

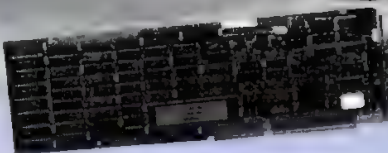
The one strange effect of this arrangement is that DOS images show up in a small section at the top center of the screen. The contents are completely legible but are in stark contrast with other designs where the 80 by 25 display is expanded to fill the entire large screen.

There are some jumpers on the card you must adjust according to the size of the slot it is going into and the sort of display adapter already installed. The documents make it easy to choose the correct settings, and the physical installation is easy.

Software installation is a little trickier. There is a main setup program that automates some of the steps, but it has one major flaw. Instead of listing the choices by model number, the screens list choices like "19-inch portrait" and "24-inch landscape." This can be confusing if you do not know the correct description for the machine you have; it would be better to see more straightforward choices like "Viking 2/91" or "Viking 2400."

Another small software-installation

It may not sport a bargain-basement price, but Monterm's Viking 2400 (24-inch) model offers high display quality and drivers that don't disappoint. A definite contrast is the install process, which is almost annoying.



problem is that you need to create a new backup copy of one of the *Microsoft Windows/286* setup disks. Other install programs take advantage of the *Windows/286* SETUP program's ability to load drivers from third-party disks, and Monterm could save users some work by following suit.

In the benchmark tests, both models performed similarly. They were just slightly slower than average on the DOS and *AutoCAD* tests, but they handled the *Windows* benchmark test extremely well. Chalk it up to the generally good drivers included with each system.

And since the adapter card is capable of creating a bitmapped image larger than the display, you can use a virtual-screen feature that speeds up scrolling around images. This is useful in desktop publishing or when using *Windows* with a number of windows open at once.

The display quality was good in both cases. The *Windows* image was slightly better than the *Ventura*, with marginally clearer body text on the full-page displays. The Viking 2/91 has a fairly typical tilt-and-swivel base. The 2400 is much larger and has only a rear leg to let you adjust the tilt. The 2400's big screen does offer some significant advantages, however, because it displays desktop publishing pages at full scale in facing-page display. Neither monitor showed any wavy edges or other flaws, which is especially impressive in the case of the large-screen 2400.

These two displays are good choices—but fall just short of superior. It should be

easy for the engineers at Monterm to build some sort of display emulation into the adapter card to eliminate the need for a separate slot for the standard adapter. This would simplify the installation process. And given the lower prices of products with similar performance and resolution, these two monitors don't quite stack up to the competition.

PANASONIC COMMUNICATIONS AND SYSTEMS CO.

PanaPro M1900

by Winn L. Rosch

The design goal of Panasonic's PanaPro M1900 is to let you see double—that is, two pages at a time with your favorite desktop publishing program. But the \$2,099 PanaPro can do much more than display newsletter pages. With the ability to light over a million pixels on the screen in a 1,280 by 960 array, it can bring workstation sharpness to *AutoCAD* or any of the applications its wide range of drivers supports.

Plain text-mode programs, even DOS, can tap into the PanaPro's extended modes and unfurl screens measuring up to 67 rows high by 160 columns wide—with admittedly tiny characters. The PanaPro also incorporates full Hercules graphics compatibility, although with Hercules-level resolution (720 by 348 pixels).

Unfortunately, the big, 19-inch screen

FACT FILE

Monterm Viking 2/91 and Viking 2400

Monterm Corp., 5740 Green Circle Dr., Minnetonka, MN 55343; (800) 343-4969, (612) 935-4151.

List Price: Viking 2/91, \$2,195; Viking 2400, \$2,795.

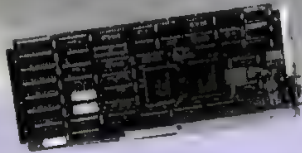
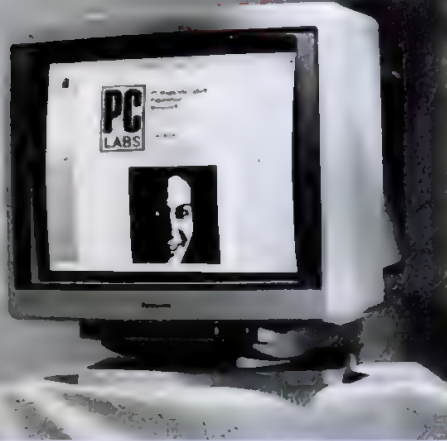
Requires: IBM PC, XT, AT, or compatible; MDA, CGA, or Hercules adapter; 8- or 16-bit slot.

In Short: These two single-shade monitors give crisp images and acceptable full-screen displays for desktop publishing. A graphics coprocessor adds speed, but the need for an additional display card, a cumbersome installation process, and top prices diminish the overall value just a notch.

CIRCLE 424 ON READER SERVICE CARD

MONITORS
PAPER-WHITE MONITORS

Panasonic's \$2,099 PanaPro M1900 isn't a star in the paper-white monitor firmament, but it does offer solid drivers and no surprises. Its simple design and fairly low price make this 19-inch model a good value.



of the PanaPro is not quite up to delivering two life-size side-by-side pages. Although it devotes a generous swath of its screen to active imaging—a full 17.25 inches diagonally—it's still too small for life-size looks. Moreover, the PanaPro's 92 dot-

per-inch screen is shy of exactly WYSIWYG graphics.

Then again, the PanaPro's two-page display is suited for more than just previews—text down to about six points is readable (though you might have to

squint). A companion model, the \$1,699 M1500, achieves the same resolution but with smaller-still characters on its 15-inch tube.

The screen of the PanaPro is surrounded by a battleship-gray bezel, setting it off from the pale beige of the rest of the case. Overall it looks trim and compact, even at 18 by 18.75 by 15.5 inches (HWD), counting its built-in tilt-and-swivel stand. It's FCC-rated Class A.

Unlit, the face of the PanaPro is a light gray with a definite greenish tinge. Illuminated, it comes close to being a genuine paper-white display, with just enough yellow mixed in its P40HB phosphors to warm the image up. Medium persistence; the screen responds quickly enough that ghosting is not a problem. With its 64-Hz frame rate and noninterlaced operation, there's no flicker either.

The horizontal scanning frequency used by the system is 63.95 KHz. This frequency makes but modest demands on the PanaPro monitor, which has a 110-MHz bandwidth.

The PanaPro can be used as the only monitor in your system, or it will work in conjunction with another display (or possi-

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Any interest?

MONITORS

PAPER-WHITE MONITORS

bly two displays). In its high-resolution modes, the PanaPro uses a memory range not used by other display systems, C8000(Hex) to CFFFF(Hex), so you can plug in a monochrome, CGA, EGA, or VGA in addition to it. (Conflicts are still possible because other system peripherals may also attempt to use this memory range.) When its Hercules emulation is enabled, however, the PanaPro also appropriates the memory range used by IBM's conventional Monochrome Display Adapter (MDA).

The PanaPro connects to its display

adapter using a single cable that splits into three BNC connectors at the display end. Separate connectors are used for video information, horizontal, and vertical sync signals. The three connectors are properly and legibly labeled to match the jacks on the display, so installation is quick and easy. The video input accepts analog signals, although the PanaPro display adapter generates only digital signals.

Although the PanaPro monitor itself uses analog inputs, which should theoretically endow it with unlimited gray-scale potential, the overall M1900 system can deliver only two on-screen tones—black and white. The reason: Panasonic's display adapter (actually a specially modified Cornerstone PC1280 board) has a digital output with no gray-scale support. The board has an 8-bit PC-bus interface, although a Micro Channel version is promised for delivery in May 1990.

The controls of the PanaPro are both the minimum necessary and exactly what you'll need—brightness, contrast, and power, all on the front panel. Undocumented image controls are available as

screwdriver adjustments on the rear panel.

The PanaPro includes explicit support for a wide variety of software, including *Microsoft Windows*, *GEM*, *AutoCAD*, *WordPerfect*, and the like. It will also run

**The PanaPro M1900 is for
those who want
high resolution in
black and white (only).**

anything that follows the Hercules standard, albeit with somewhat lower resolution.

The Panasonic PanaPro M1900 monitor package also includes a DOS software driver and mode-changing program along with a handful of type fonts (pseudo-Helvetica, ersatz Times Roman, Courier, and Symbols) that are for use with *GEM* and *Ventura Publisher*.

Big enough to be useful, simple enough to be usable, and elegant enough to be likable, the PanaPro M1900 makes a good choice for those who need high resolution and want it in black and white (only).

FACT FILE

PanaPro M1900
Panasonic Communications and Systems Co.,
Two Panasonic Way, Secaucus, NJ 07094; (800)
742-8086
List Price: \$2,099.
Requires: IBM XT, AT, or compatible; 8- or 16-bit slot.
In Short: A solid competitor for buyers who are searching for high resolution but don't need gray scale. Graphics are a little short of WYSIWYG, but otherwise this model is a good value.

CIRCLE 425 ON READER SERVICE CARD

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CIRCLE 235 ON READER SERVICE CARD

MONITORS
PAPER-WHITE MONITORS

SAMPO CORP. OF AMERICA

OfficePRO II

by Alfred Poor

Sampo Corp. of America has been playing an active backstage part in the computer and electronics industry for many years, building monitors and other components for various vendors. Now the company is offering products under its own label, including the \$1,790 OfficePRO II display system.

The system is built around a 20-inch black-and-white screen in a case with a tilt-and-swivel base. Sampo also includes a controller card provided by Cornerstone

**You might guess from
the list price that
the OfficePRO II
operates without the
benefit of a graphics
processor, yet
our test results do not
indicate any
performance handicaps.**

Technology that is nearly identical to the card that comes with the Taxan system also reviewed here.

The monitor itself can support multiple scanning frequencies and is capable of 1,280 by 960 resolution—about average for this class of displays.

The Cornerstone display adapter is a 16-bit card that can also work in an 8-bit slot. Installation is easy, and since the card emulates a Hercules adapter without need for any special drivers, you don't need to have a separate monitor installed. The card is also designed to work in harmony with other display adapters, although we did not test this feature.

The OfficePRO II comes with a plethora of special drivers for common applications. The graphics drivers support the full 1,280 by 960 resolution of the monitor, and there are special text modes for *Lotus 1-2-3* and *WordPerfect* that can display 160 columns and 67 lines of text on a single screen.

One of the best buys in the bunch, Sampo's OfficePRO II is an inexpensive, well-designed, midrange performer. Installation is trouble-free, and for the most part text is exceptionally sharp.

The drivers come with a typical Cornerstone utility. This setup program automates the driver installation process, and does everything for you or just gives you the instructions necessary to complete the task. While it does not do the *Windows* installation for you, it is designed so that you can use the extra disk option in the normal *Windows* setup procedure. This means that you don't have to spend time making extra copies of your *Windows* setup disk.

As you might expect from the price, the OfficePRO II is only black and white—it provides no gray-scale support. Still, the system manages to produce excellent images. The *Windows* support was especially good, producing sharp, clear screens. The small body text in the two-page *Page-Maker* display was clearly legible even if the characters did lose some definition, but the *Ventura Publisher* driver was clearly not up to the same quality. Small *Ventura*

body text in a full-page display was difficult to read.

You might also guess from the list price that the OfficePRO II operates without the benefit of a graphics coprocessor—correct again. Yet our test results do not indicate any performance handicaps because of the absence of a coprocessor. In fact, the OfficePRO II managed to turn in good DOS benchmark test times and was average in the *Windows* benchmark test.

Sampo intends to go after the large-screen monitor market in a big way, and the OfficePRO II is only its first product in this arena. The company intends to offer the OfficePRO IIA, which boasts a 20-inch display and offers 256 shades of gray, 16 times more gray-scale possibilities than any of the 16-level gray-scale systems reviewed here. It promises some spectacular pictures, especially for halftone images in desktop publishing applications. Unfortunately, Sampo was unable to provide us with a working production package in time for this review.

Sampo Corp. has a lot of experience in building monitors, and the OfficePRO II shows signs of Sampo's specialized knowledge. Sampo should also receive credit for teaming its tubes with the Cornerstone adapter, which offers plenty of benefits of its own. While the OfficePRO II's particular monitor-and-adapter combination did not produce the best images or times in its class, the Sampo display remains an attractive value because of its low list price, ease of installation, and friendly user characteristics.

FACT FILE

OfficePRO II
Sampo Corp. of America, 5550 Peachtree Industrial Blvd., Norcross, GA 30071; (404) 449-6220.
List Price: \$1,790.
Requires: IBM PC, XT, AT, PS/2 Model 25 or 30, or compatible; 8- or 16-bit slot.
In Short: The Sampo OfficePRO II carries an attractive price, comes with a Cornerstone adapter and drivers, and produces good black-and-white screens (though a bit better for *Microsoft Windows* than for *Ventura Publisher*).

CIRCLE 426 ON READER SERVICE CARD

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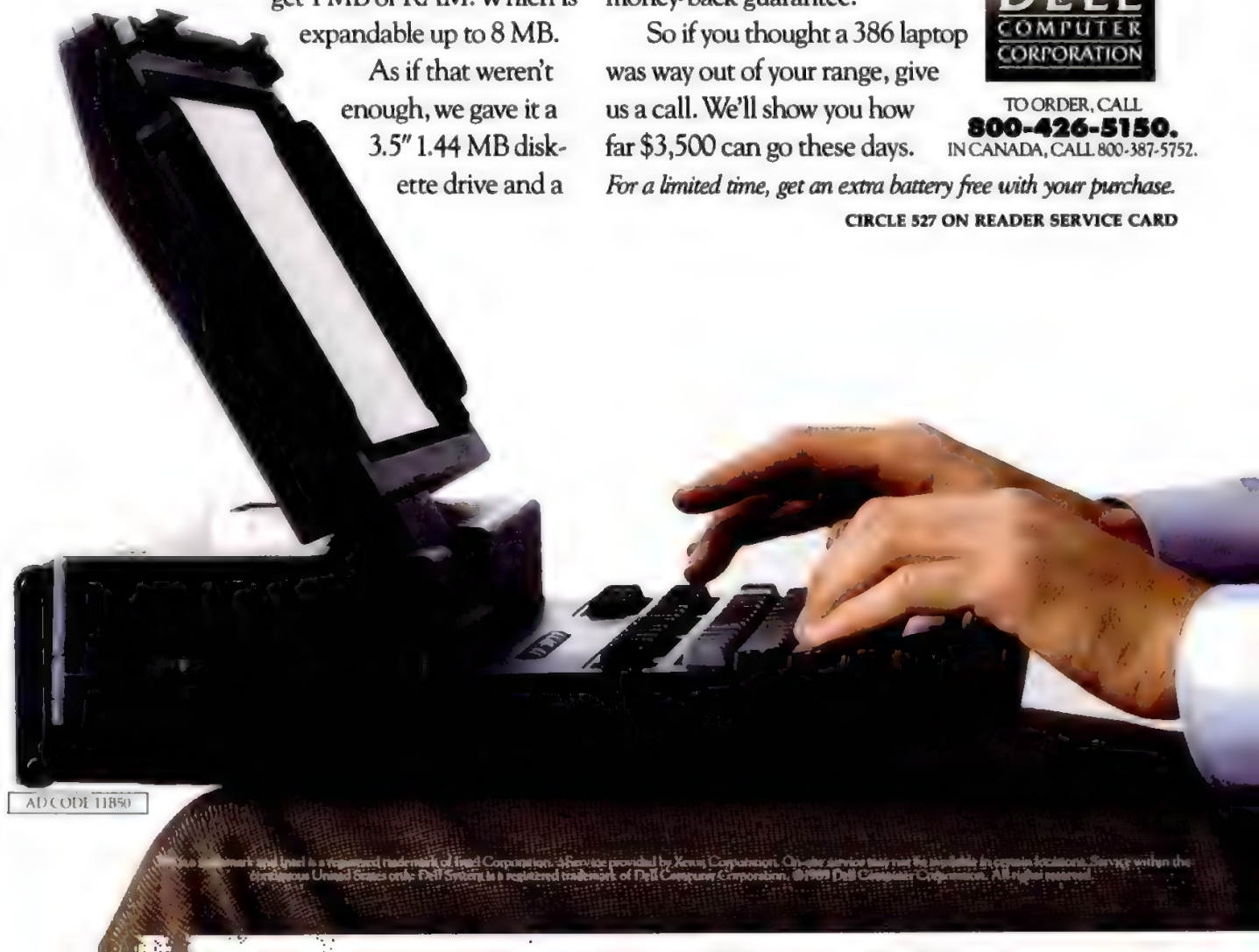
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MONITORS

PAPER-WHITE MONITORS



SUMMARY OF FEATURES: PAPER-WHITE MONITORS

Products listed in ascending price order

Each of these paper-white systems includes both display card and monitor; as the systems were not designed to be used with other display cards, they lack certain inputs and controls. None of the tested monitors came with inputs for composite video or separate sync, since they were not intended for use with those types of signals.

Every one of the monitors has a brightness control. None of them came with vertical hold or black/white reverse controls; the latter option is important for users who prefer to work with white text on a black background.

Length of phosphor persistence gives an idea of how long a phosphor stays illuminated after being excited by an electron beam. A monitor with "medium" phosphor persistence might have a range of 30 to 300 milliseconds.

Software drivers A driver that supports a given application will not necessarily work with every version. Also note that the list of "other" software is selective; it mentions those applications we consider most significant. For more detailed information about compatibility, please contact the vendor of any monitor you are considering.

	DesignView/19 Elite Business Applications Inc. \$1,695	OfficePRO II Sampo Corp. of America \$1,790	Genius ² Model 1920M Micro Display Systems Inc. \$1,995	Panorama Xerox Corp. \$1,995	PanaPro M1900 Panasonic Communications and Systems Co. \$2,099	Moniterm Viking 2/91 Moniterm Corp. \$2,195
PHYSICAL SPECIFICATIONS						
Dimensions						
Screen size (tube):						
Diagonal	20	20	19	19	19	19.6
Width	16.8	16.8	14.8	14.4	15	15.2
Height	13.6	13.6	11	10.8	11.5	13
Active display area:						
Diagonal	17.5	17.3	17.8	18	17.3	18.5
Width	13.8	13.4	14.3	14.4	13.8	14
Height	10.8	10.5	10.5	10.6	10.3	11
Case dimensions:						
Height	17.5	16.9	19.8	18	18	17
Width	18.8	18.8	18.8	19	18.3	18.5
Depth	17	17.5	16.3	16.8	15.5	16
Footprint:						
Width	12.5	12.7	10	11	13	15.5
Depth	11	11	11.6	10.8	13	11
Weight (pounds)	46	46	46	38	42	39
Length of monitor cable	72	70	68	72	60	72
Cable removable at monitor end	☐	☐	☐	☐	☒	☒
ELECTRONIC SPECIFICATIONS						
Maximum resolution (pixels)	1,280 x 1,024	1,280 x 960	1,280 x 1,024	1,216 x 925	1,280 x 960	1,280 x 960
Length of phosphor persistence	Short	Medium/short	Medium/short	Info not available	Medium	Short
Video bandwidth (MHz)	110	120	110	57	110	110
Vertical scanning frequency (Hz)	64	49-64	61	38	64.01	66
Horizontal scanning frequency (KHz)	68	61.66-66.4	65.23	37.25	63.95	66
Spot size (millimeters)	.28	.30	.29	Info not available	.27	.25
Dots per inch	96	92	100	80	92	91
Number of gray scales supported	2	2	4	2	2	2
Depth of bezel (inches):						
At top center	.5	1.6	.3	.3	.3	1
At side center	.4	.9	.3	.5	.3	.5
FCC rating	A	A	A	B	A	A
INPUTS/OUTPUTS						
Inputs:						
Analog (separate socket or switch-selectable)	☐	☐	☐	☐	☒ (socket)	☐
TTL	☒	☐	☒	☐	☐	☐
Composite	☐	☐	☐	☐	☐	☐
Separate sync	☐	☐	☐	☐	☒	☐
Other	ECL	ECL	ECL	ECL	None	ECL

☒—Editor's Choice

☒—Yes

☐—No

MONITORS

PAPER-WHITE MONITORS

Taxan
CrystalView
1901
Taxan USA Corp.

 **Wyse WY-7190**
Wyse Technology

Sigma L-View PC
Sigma Designs

Monitorm
Viking 2/72GS
Monitorm Corp.

Ventek AT2000
Ventek Corp.

Monitorm
Viking 2400
Monitorm Corp.

 **DualPage**
Cornerstone
Technology

Image Systems
M24L
Image Systems
Corp.

18.5	20	19	19.6	20	24	19	24
11.8	18.7	15.5	15.2	17	18	13.8	20.5
11	15.6	12	13	13.5	14	10.8	16.5

17.5	17.3	17.4	17.5	17	22	17.6	21.8
13.8	13.5	14	14	13.6	17.5	13.6	17.8
10.6	10.4	10.4	10.3	10.9	13.5	10.8	12.5

17.5	17.5	17.3	14.5	18.5	17.8	18.5	21
18.8	19.8	19	17.8	18	21.4	18	22
17	16.5	16.8	15	15	17	16.3	16

12.5	9.4	8.8	15.5	11	16.5	11.6	11.8
11	9.4	8.8	11	11	12	11.6	11.5
48	60	47	36	60	50	49	60
70	72	72	50	72	72	72	60

□	■	■	■	■	■	■	■
---	---	---	---	---	---	---	---

1,280 x 960	1,280 x 1,024	1,664 x 1,200	1,024 x 768	1,280 x 1,024	1,280 x 960	1,600 x 1,280	2,048 x 1,536
Short	Short	Medium	Short	Medium/short	Short	Medium/short	Short
105	90	160	64	120	110	200	200
63.54	58-80	60	60	60-70	66	67	60-80
63.73	42-71	75	50	64	66	89	48-96
Info not available	.40	.40	Info not available	.27	.25	Info not available	.25
96	93	120	72	94	72	118	92
2	2	4	16	64	2	16	16

1.8	.4	.3	1	.4	1.6	1.1	.6
1	.8	.4	.5	.5	.4	.6	1
A	A	A	A	A	A	A	A

□	□	□	■ (socket)	■ (socket)	□	□	■ (either)
□	□	□	□	□	□	□	■
□	■	□	□	□	□	□	■
□	■	□	□	■	□	□	■
ECL	None	ECL	None	None	ECL	None	ECL

CONTINUES

MONITORS

PAPER-WHITE MONITORS



SUMMARY OF FEATURES: PAPER-WHITE MONITORS

Products listed in ascending price order

	DesignView/19 Elite Business Applications Inc.	OfficePRO II Sampo Corp. of America	Genius ² Model 1920M Micro Display Systems Inc.	Panorama Xerox Corp.	PanaPro M1900 Panasonic Communications and Systems Co.	Monitorm Viking 2/91 Monitorm Corp.
INPUTS/OUTPUTS						
Outputs:						
Analog	☐	☐	☐	☐	☐	☐
TTL	☐	☐	☒	☐	☐	☐
Other	None	None	None	None	None	None
CONTROLS						
Power	☒	☒	☒	☐	☒	☒
Contrast	☐	☐	☒	☐	☒	☐
Horizontal position	☐	☐	☐	☐	☐	☐
Vertical position	☐	☐	☐	☐	☐	☐
Horizontal size	☐	☐	☐	☐	☐	☐
Vertical size	☐	☐	☐	☐	☐	☐
Other	115/230V AC	None	None	None	None	None
FEATURES						
Compatibility:						
MDA	☒	☐	☒	☐	☐	☐
Hercules	☒	☐	☒	☐	☒	☐
CGA	☒	☐	☒	☐	☐	☐
EGA	☐	☐	☒ (through drivers)	☐	☐	☐
VGA	☐	☐	☒ (through drivers)	☐	☐	☐
Super VGA	☐	☐	☐	☐	☐	☐
8514	☐	☐	☐	☐	☐	☐
Tilt (range in degrees)	☒ (20)	☒ (20)	☒ (20)	☐	☒ (20)	☒ (30)
Swivel (range in degrees)	☒ (90)	☒ (90)	☒ (90)	☒ (90)	☒ (180)	☒ (90)
Programmable (through its own processor)	☐	☐	☐	☐	☐	☐
Other	None	None	None	None	None	None
DISPLAY BOARD						
Board	16-bit	16-bit	8-bit	8-bit	8-bit	16-bit
16-bit board will work in an 8-bit slot	☒	☒	N/A	N/A	N/A	☒
Video BIOS supported (8- or 16-bit)	Both	8-bit	8-bit	8-bit	8-bit	Both
Video RAM supported (8- or 16-bit)	Both	8-bit	8-bit	8-bit	8-bit	Both
MCA version available	☒	☐	☐	☐	☒	☒
Video compatibility:						
MDA	☒	☐	☒	☒	☒	☒
Hercules	☒	☒	☒	☒	☒	☒
CGA	☒	☐	☒	☒	☐	☒
EGA	☐	☐	☐	☐	☐	☐
VGA	☐	☐	☐	☐	☐	☐
Super VGA	☐	☐	☐	☐	☐	☐
8514	☐	☐	☐	☐	☐	☐
Resolutions supported	720 x 350, 1,280 x 1,024	720 x 348, 1,280 x 960	720 x 340, 736 x 1,000, 1,280 x 1,024	1,152 x 860	720 x 348, 1,280 x 960	640 x 200, 720 x 348, 1,280 x 960

☒—Editor's Choice ☒—Yes ☐—No
N/A—Not applicable: this monitor uses an 8-bit board.

MONITORS

PAPER-WHITE MONITORS

Taxan CrystalView 1901 Taxan USA Corp.	Wyse WY-7190 Wyse Technology	Sigma L-View PC Sigma Designs	Monitorm Viking 2/72GS Monitorm Corp.	Ventek AT2000 Ventek Corp.	Monitorm Viking 2400 Monitorm Corp.	DualPage Cornerstone Technology	Image Systems M24L Image Systems Corp.
☐	☐	☐	☒	☐	☐	☐	☐
None	None	None	None	None	None	None	ECL
☒	☒	☒	☒	☒	☒	☒	☒
☐	☒	☒	☐	☐	☐	☐	☒
☐	☒	☐	☐	☐	☐	☐	☒
☐	☒	☐	☐	☐	☐	☐	☒
115/230V AC	Low/high Z, external/internal synchronization	None	None	115/220V AC	None	None	None
☐	☒	☒	☐	☒	☐	☐	☐
☒	☒	☒	☐	☒	☐	☒	☒
☐	☐	☐	☐	☒	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐
☒ (30)	☒ (30)	☒ (25)	☒ (30)	☒ (20)	☒ (20)	☒ (45)	☒ (20)
☒ (90)	☒ (270)	☒ (360)	☒ (180)	☒ (180)	☐	☒ (360)	☒ (360)
☐	☒	☐	☐	☐	☐	☐	☐
None	None	None	None	Dynamic pixel aspect-ratio adjustment	None	None	None
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
☒	☐	☒	☒	☒	☒	☒	☒
Both	8-bit	8-bit	Both	Both	Both	Both	Both
Both	16-bit	8-bit	Both	Both	Both	8-bit	Both
☐	☐	☒	☐	☒	☒	☐	☒
☐	☒	☒	☐	☒	☒	☐	☐
☒	☒	☒	☐	☒	☒	☒	☐
☐	☒	☐	☐	☒	☒	☐	☐
☐	Optional (\$345)	☐	☐	☒	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐
720 x 348, 1,280 x 960	1,280 x 800, 1,280 x 960, 1,280 x 1,024	640 x 350, 720 x 348, 1,664 x 1,200	1,024 x 768	1,280 x 960, 1,280 x 1,024	640 x 200, 720 x 348, 1,280 x 960	1,600 x 1,280	720 x 348, 1,600 x 1,280

CONTINUES

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- 3 1/2" format available from us. Specify when ordering.
 □ package includes both 5 1/4" and 3 1/2" disks.
 B 3 1/2" format available from manufacturer by request. Call us for details.
 CP—copy-protected; NCP—not copy-protected.

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

SOFTWARE

We only carry the latest versions of products. Version numbers in our ads are current at press time.

- Aldus ... NCP**
 1332 □PageMaker 3.0 call
Alpha Software ... NCP
 5104 □ALPHAfour 1.1 319.
 4103 □ALPHAworks 2.0 special thru 2/28 89.
American Small Business Computers ... NCP
 1191 □Design CAD 3.1 159.
 1192 □Design CAD 3D 2.2 209.



FormWorx ... NCP

□FormWorx with Fill & File 2.5—Forms design, forms fill-in, & direct read/write compatibility with dBASE files ... all in one complete, easy-to-use package. Never re-type a thing. ... \$85.

- Application Techniques ... NCP**
 1214 □Pizazz Plus 1.3 69.
Ashton-Tate ... NCP
 4450 □dBASE IV 1.0 499.
Autodesk ... NCP
 4519 □Autosketch 2.0 95.
 6119 □Autosketch Animator 1.0 189.
Avery ... NCP
 6034 □List & Mail Plus 2.0 39.
 6006 □Label Pro 1.0 49.
Bitstream ... NCP
 □Fundamentals:
 Reports and Proposals, Presentations
 or Spreadsheets each 159.
 □Headlines (1 to 6) each 99.
 □Individual Fonts each 99.



Bloc Publishing ... NCP

- PopDropPLUS 1.0—Allows users to load RAM-resident programs into expanded memory. \$59.
 □PrintRate 1.3—Powerful print spooling software. Supports up to 5 printers and provides netbios 59.

Bloc Publishing ... NCP

- 5414 □Fast Pak Mail 4.0 49.
 6011 □Corporate Ladder 1.1 49.
 1447 □Form Tool 2.01 55.
 6245 □PopDropPLUS 1.0 59.
 6012 □PrintRate 1.3 59.
 4594 □Form Filler 2.0 89.

Borland International ... NCP

- 1498 □Turbo C 2.0 105.
 4330 □Turbo C Professional Pack 1.0 175.
 5335 □Turbo Pascal 5.5 105.
 4332 □Turbo Pascal Professional Pack 1.0 175.
 6242 □Quattro Pro 1.0 289.
 1514 □Paradox 3.0 call

Bourbaki ... NCP

- 4524 □1DIR+ 3.0 49.

Bridgeway Publishing ... NCP

- 4386 □FastTrax 3.9 35.

Brightbill-Roberts ... NCP

- 5408 □Hyperpad 1.0 89.
 5843 □Show Partner F/X 3.5 229.

Broderbund ... CP

- 6295 □The Playroom 32.
 1434 □New Print Shop 39.
 1433 □Memory Mate 3.01 (NCP) 45.

Caere ... NCP

- 6004 □Omnipage 386 2.0 599.

Central Point ... NCP

- 5039 □PC Tools Deluxe 5.5 77.
 5038 □Copy II PC 5.0 27.
 6179 □PC Tools Deluxe LAN 5.5 529.

Chipsoft ... NCP

- 1663 □TurboTax for 1989 Taxes 7.0 45.
 □Individual States each 34.

Chronos Software ... NCP

- 4387 □Who•What•When 1.09 119.

Computer Associates ... NCP

- 4934 □SuperCalc 5 1.0 319.

Corel Systems ... NCP

- 5506 □Corel Draw 1.1 329.

Crosstalk Communications ... NCP

- 2911 □Remote? 2.0 109.
 2908 □Crosstalk XVI 3.7 109.
 5611 □Crosstalk for Windows 1.0 129.

DacEasy ... NCP

- 1756 □Dac Easy Payroll 4.0 \$59.
 1748 □Dac Easy Accounting 4.0 89.
 3209 □Lucid 3D 2.2 59.

Data Storm ... NCP

- 4798 □PROCOMM PLUS 1.1 52.

Delrina Technology ... NCP

- 4325 □PerFORM 2.0 169.

Delta Technology ... NCP

- 5829 □Direct Access 4.1 52.

Digital Composition Systems ... NCP

- 5876 □db Publisher Report Maker 2.0 185.

Dow Jones ... NCP

- 5494 □News/Retrieval Membership Pkg. 24.

5th Generation ... NCP

- 5504 □Brooklyn Bridge 3.0 79.

- 3950 □Fastback Plus 2.09 109.

FormWorx ... NCP

- 5810 □FormWorx with Fill & File 2.5 85.

Fox Software ... NCP

- 6188 □FoxPro 1.0 489.

- 2233 □Foxbase Plus 2.1 199.

Funk Software ... NCP

- 2228 □Sideways 3.21 42.

- 4479 □Allways 1.0 85.

Generic Software ... NCP

- 2265 □Generic CADD Level 3 1.13 169.

Great American Software ... NCP

- 4880 □One Write Plus Accounting Sys. 2.0 179.

- 4879 □One Write Plus Payroll 2.05 89.

- 5825 □Money Matters 1.0 55.

- 4878 □Dome Accounting By Computer 2.0 25.

Harvard Associates ... NCP

- 2324 □PC Logo 3.0 59.

Hayes ... NCP

- 2293 □Smartcom II 3.0 89.

Hilgraeve ... NCP

- 2323 □HyperACCESS/5 1.0 (DOS & OS/2) 115.

IBM ... NCP

- 6187 □Storyboard Plus 2.0 239.

- 6186 □DisplayWrite 4 2.0 249.

Individual Software ... NCP

- 2408 □Professor DOS 4.0 27.

- 6222 □Resume Maker 1.0 29.



Chipsoft ... NCP

□Turbo Tax 1989 Personal 1040 7.0—Award winning tax preparation software with over 50 federal income tax forms & schedules. Includes a cross-referenced help system. 1989 World Class PC Award Winner . \$45.

PC CONNECTION®

and now into the night.



Microsoft ... NCP

Excel for OS/2 1.0—Spreadsheet which allows you to take full advantage of the power and flexibility of OS/2. Sophisticated analytical tools, easy-to-use Presentation Manager interface, and much more \$339.

Intuit ... NCP	
2426	Quicken 3.0 39.
Lord Publishing ... NCP	
5191	Ronstadt's Financials 1.02 145.
Lotus ... NCP	
5417	1-2-3 3.0 call
5653	1-2-3 2.2 call
5134	Magellan 1.0 149.
4131	Agenda 1.0 275.
2660	Freelance Plus 3.01 345.
MECA ... NCP	
4529	CheckWrite Plus 1.1 29.
4603	Andrew Tobias' Tax Cut for 1989 Taxes 49.
2798	Managing Your Money 6.0 119.
Microcom ... NCP	
2775	CarbonCopy Plus 5.1 (2 req.) 115.
6236	Relay Gold 4.0 149.
Micrografx ... NCP	
6294	Draw Plus 1.0 289.
Micro Logic ... NCP	
2968	Tornado 1.8 55.
Microlytics ... NCP	
2731	GOfier 2.0 (new version) 45.
Microrim ... NCP	
2835	R:BASE for DOS (version 2.1) 489.
Microsoft ... NCP	
2860	Learning DOS 2.0 35.
2899	Windows 286 2.1 69.
2904	Works 2.0 99.
2900	Windows 386 2.1 129.
2901	Word 5.0 209.
6195	Word for Windows 329.
2856	Excel 2.1 (req. 80286/80386) call
6033	Excel for OS/2 1.0 339.
5188	QuickPascal 1.0 69.
2894	QuickBASIC 4.5 69.
2895	QuickC 2.0 69.
2853	QC Compiler 5.1 299.
Mouse Systems ... NCP	
5739	Power Panel 1.0 59.
5995	Marq Plus 1.0 59.
Multisoft ... NCP	
4925	PC-Kwik Power Pak 1.5 79.

Nantucket Software ... NCP

2970 Clipper (Summer '87) \$429.

New England Software ... NCP

4337 GB-Stat 1.5 159.

Nolo Press ... NCP

2982 WillMaker 3.0 35.

5122 For The Record 1.0 35.

North Edge Software ... NCP

2987 Timeslips III 3.4 169.

4277 Timeslips III Network Edition 3.4 399.

Norton-Lambert ... NCP

4928 Close-Up Customer 3.0 135.

4929 Close-Up Support 3.0 165.

5420 Close-Up LAN (8 user) 529.

On Track Computer Sys. ... NCP

5490 Disk Manager 4.0 49.

Paperback Software ... NCP

3142 VP-Planner 3D 1.0 169.

PC Globe ... NCP

5902 PC Globe 3.0 39.

5900 PC USA 1.0 39.

Personics ... NCP

3126 SeeMORE 2.0 54.

4328 Look & Link 1.1 59.

Peter Norton ... NCP

3152 Norton Commander 3.0 89.

3146 Advanced Utilities 4.5 89.

Quarterdeck ... NCP

3221 Expanded Memory Mgr. 386 5.0 59.

3220 DESQView 2.26 79.

4586 DESQView 386 129.

Reference Software ... NCP

4396 Grammatik IV 1.0 52.

Revolution Software ... NCP

4480 VGA Dimmer 2.01 (screen saver) 19.

3254 Cruise Control 3.02 39.



North Edge Software ... NCP

Timeslips III 3.4—Track every minute's efforts, then print the invoice and log the receivable all from the convenience of Timeslips III. Menu-driven and memory resident, this is a must for your service business. \$169.

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MMC
Micro Management Corporation

PC Connection
6 Mill Street
Marlow, NH 03456

690M

SALES 603/446-7721 FAX 603/446-7791

RightSoft ... NCP

4155 RightWriter 3.1 \$54.

Samna ... NCP

5799 Ami Professional 1.0 319.

Softlogic Solutions ... NCP

3546 Disk Optimizer 4.05 45.

3542 Software Carousel 3.01 55.

Softview ... NCP

3474 MacInTax for Windows (1989 taxes) 65.



Software Publishing ... NCP

Harvard Graphics 2.13—Be "free and easy" with the industry's best-selling presentation graphics package. Now with Draw Partner—a free drawing accessory (normally \$149 List). Graphically the best choice. \$339.

Software Publishing ... NCP

3499 PFS:First Publisher 2.1 89.

3481 PFS:First Publisher Art Gallery 1.0 84.

4342 PFS:First Graphics 1.0 89.

3478 PFS:First Choice 3.02 105.

3496 Professional Write 2.11 149.

3493 Professional File 2.01 199.

3482 Harvard Graphics 2.13 339.

4669 Harvard Graphics Access. Pk. 1.0 299.

5992 Office in a Box (includes First Choice, First Publisher, & Intuit Quicken 3.0) 159.

Spinnaker ... NCP

4441 Resume Kit 1.29 25.

4446 8-in-1 2.0 39.

Symantec ... NCP

5383 Budget Express 1.0 99.

3427 Q & A Write 1.01 139.

3412 Grandview 1.0 189.

3425 Q & A 3.0 229.

3431 Timeline 3.0 399.

TOPS ... NCP

3724 NetPrint 2.0 (share printers) 119.

3726 TOPS 2.1 115.

3725 TOPS Repeater 125.

3720 Flashcard 2.1 (AppleTalk network card; 1 year warranty) 159.

Traveling Software ... NCP

4190 Battery Watch 2.0 (3 1/2" only) 35.

3729 LapLink Mac 2.0 79.

5179 LapLink III 3.0 85.

3727 DeskLink 2.2 99.

True BASIC ... NCP

3561 True BASIC 3.0 52.

Vericom ... NCP

3765 SoftBytes 2.0 35.

Hours after sunset

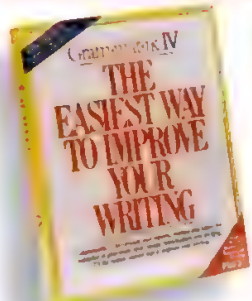
- Volkswriter ... NCP**
 5046 ☒ Volkswriter 4 (w/Correct Grammar) \$109.
WordPerfect Corp. ... NCP
 3799 ☒ WordPerfect Library 2.0 75.
 3804 ☐ WordPerfect 5.1 265.
 3806 Additional Network Stations 5.1 ... 169.
WordStar USA ... NCP
 2825 ☐ WordStar Prof. Release 5.5 229.
 5000 ☐ Upgrade to Release 5.5 89.
Wordtech Systems ... NCP
 3810 ☐ DBXL 1.3 145.
Xerox ... NCP
 5084 ☒ Xerox Presents 1.0 339.
 4539 ☒ Professional Extensions 1.0 389.
 3812 ☐ Ventura Publisher 2.0 call
XTREE ... NCP
 6161 ☒ XTREE Pro Gold 1.0 75.
 5526 ☒ XTREENet File Server 229.
XYQUEST ... NCP
 4393 ☐ XyWrite III Plus 3.55 229.



Broderbund ... CP
☒ *The Playroom*—Everything your child touches comes alive with fun and learning. Kids from preschool to early elementary will enjoy activities in reading or math readiness, or just plain Fun! \$32.

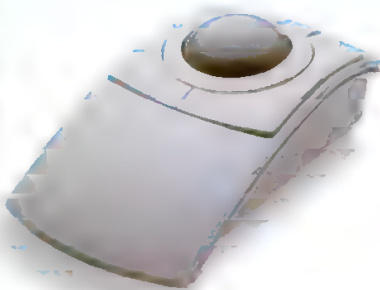
RECREATIONAL/EDUCATIONAL

- Accolade ... CP**
 6031 ☐ Hardball 2 26.
 6030 ☐ Test Drive 2: The Duel 29.
Broderbund ... CP
 1417 ☐ Where/Europe Carmen Sandiego? 29.
 5701 ☐ Where/Time Carmen Sandiego? ... 32.
 5851 ☒ Sim City 33.
Electronic Arts ... CP
 5798 ☐ Ferrari Formula I 29.
 5806 ☐ F-16 35.
 4659 ☒ Chessmaster 2100 35.
 5804 ☒ Deluxe Paint II (Enhanced) 89.
Konami/Ultra Software ... CP
 6194 ☐ Teenage Mutant Ninja Turtles 29.
Microprose ... CP
 4454 ☐ F-19 Stealth Fighter 39.
 5823 ☐ Red Storm Rising 39.
Microsoft ... NCP
 2858 ☐ Flight Simulator 4.0 All New 39.
Parlor Software ... CP
 3159 ☐ Bridge Parlor 2.3 49.



Reference Software ... NCP
☒ *Grammatik IV 1.0*—Checks for grammar, style, usage, punctuation and spelling errors in one pass! Now works within WordPerfect 5.1, Microsoft Word 5.0, Professional Write 2.1, WordStar 5.5, XY Write III & more. \$52.

- Sierra On-Line ... CP**
 6023 ☒ Leisure Suit Larry III 39.
 4345 ☒ King's Quest IV (512k version) ... 39.
 5695 ☒ Manhunter: San Francisco 33.
 4456 ☒ Police Quest II 39.
 5106 ☒ Space Quest III 36.
 6022 ☒ Colonel's Bequest 36.
Spectrum Holobyte ... NCP
 5993 ☒ Welltris (Tetris sequel) 22.
 4283 ☒ Falcon/AT (F-16 simulation) 32.
 5187 ☒ Vette 32.
Spinnaker ... CP
 5580 ☐ Sargon IV 32.
Stone & Assoc. ... NCP
 3435 ☒ My Letters, Numbers, Words (2 to 6) 22.
 3439 ☐ 2nd Math (ages 7 to 16) 27.
Sublogic ... NCP
 3335 ☐ Jet (requires CGA or EGA) 33.
True BASIC, Inc. ... NCP
☒ Kemeny/Kurtz Math Series:
 10 titles 4.0 each 45.



MicroSpeed ... 1 year
PC-IRAC Trackball—New ergonomic design requires a desk space less than 4 inches wide. Emulates two button mice and includes software drivers to adjust resolution.
PC-IRAC Serial \$75. *PC-IRAC Bus* \$85.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

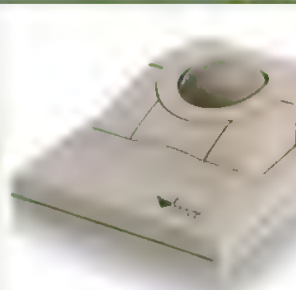
- AST Research ... 2 years**
 1223 I/O Mini 2 C/S/P \$89.
 1299 SixPakPlus 384k C/S/P 189.
 4107 RAMpage Plus 286 512k 419.
Brother International ... 1 year
 5787 HL-8e Laser Printer 1899.
 5788 HL-8Ps PostScript Laser Printer ... call
 5786 Toner/Drum Kit 99.
Central Point ... 1 year
 5042 Copy II PC Deluxe Option Board .. 115.
Compucable ... 2 years
 1604 2-Position switch box 25.
 1605 3-Position switch box 35.



Revolution Software ... NCP
☒ *Cruise Control 3.02*—Boost cursor speed. Stop cursor run-on. "Highly recommended", Jim Seymour, *PC Week* \$39.
☒ *VGA Dimmer 2.01*—Screen saver for VGA, EGA, CGA, Hercules, Mono 19.

- Corvus ... 1 year**
 6184 ReadyNet Starter Kit 319.
 6183 ReadyNet Add-On Kit 165.
Cuesta ... 1 year
 1608 Datasaver 400 Watt (power backup) 429.
Curtis ... lifetime
 1689 Diamond 29.
 1690 Diamond Plus 41.
 1694 Emerald SP-2 36.
 1707 Ruby SPF-2 (6 outlets; EMI/RFI filtered; 6 ft cord) 55.
 1708 Ruby-Plus SPF-2 Plus (w/FAX & modem protection) 65.
Diconix ... 1 year
 5655 150 Plus Printer (Parallel) 359.
Epson ... 1 year
 We are an authorized Epson Service Center.
 1906 FX-850 (80 col., 264 cps, 9 pin) ... call
 1904 FX-1050 (136 col., 264 cps, 9 pin) .. call
 5183 LQ-510 (80 col., 180 cps, 24 pin) .. 349.
 1930 LQ-850 (80 col., 264 cps, 24 pin) .. call

we're still not done.



Mouse Systems ... 1 year
PC Trackball—Get mouse functionality with a fraction of the desk space. 100% Microsoft Mouse compatible. Includes Pop-Up Menus, Ultra-Res, and Presentation Magician software. *Serial*..... \$75. *Bus*..... \$85.

- 4117 LQ-950 (110 col., 220 cps, 24 pin) . call
 1917 LQ-1050 (136 col., 264 cps, 24 pin) call
 4116 LQ-2550 (136 col., 333 cps, 24 pin) call
 5184 LX-810 (80 col., 180 cps, 9 pin) . 199.
 1052 Printer-to-IBM cable (6 feet) 15.
5th Generation ... 1 year
 3952 Logical Connection 512k. 529.
Hayes ... 2 years
 2304 Smartmodem 1200 289.
 2307 Smartmodem 2400 429.
 2308 Smartmodem 2400B (w/Smartcom II) 429.
Hercules ... 2 years
 2318 Graphics Card Plus. 189.
 5120 VGA Card. 189.
Intel ... 5 years
 4696 2400B Internal Modem 159.
 2352 2400B Internal Modem 2 (for PS/2) 249.
 5119 2400 Baud External Modem 179.
 2346 Inboard 386/PC w/1 Meg 579.
 4266 Above Board Plus 512k 419.
 4267 Above Board Plus I/O 512k 449.
 5336 Above Board Plus 8 2 Meg 699.
 5342 Above Board Plus 8 I/O 2 Meg 739.
 4272 Above Board 2 Plus 512k 469.
 5396 Above Board MC 32 0k
 (upgradable to 8 Meg) 359.
 4275 Connection Coprocessor 769.
MATH COPROCESSORS
 2370 80287-8 (for 8 MHz 80286 CPU's) . 199.
 2369 80287-10 (for PS/2 Models 50 & 60) 229.
 4750 80387SX (for 80386SX CPU's) . . . 309.
 2371 80387 (for 16 MHz 80386 CPU's) . . 349.
 2372 80387-20 (for 20 MHz 80386 CPU's) 399.
Kensington Microware ... 1 year
 2582 Masterpiece Plus 109.
 5697 Expert Mouse (Trackball for PS/2) . 115.
Key Tronic ... 3 years
 4518 101 Plus Keyboard 99.
Kraft ... 5 years
 5801 New Game Adapter (2 game ports). 27.
 5800 3 button Thunder Joystick 29.
 5802 Trackball. 69.
Logitech ... limited lifetime
 5464 Series 2 Mouse (C9 for PS/2's) . . . 69.

- 5151 HiREZ Mouse (C9) \$85.
 6029 Trackman (Trackball) serial 85. bus 89.
 4297 ScanMan Plus (hand scanner) . . . 185.
Magnavox ... 2 years
 5990 13" VGA Monitor (CM9032)(1 yr. wrnty) 349.
 4761 13" VGA Monitor (9CM062) 389.
Micron Technology ... 2 years
 5818 Beyond 640 EMS Board 1 MB
 (exp. to 8 MB w/daughter card) 369.
 5821 Beyond EX Extended Memory Board 2 MB
 (exp. to 4 MB w/daughter card) 599.
 6005 Ascend Memory Board for Compaq
 (4 Meg) 729.
Microsoft ... lifetime
 2897 Mouse with Paintbrush 109.
 2898 Mouse with Windows 286 2.1 139.
MicroSpeed ... 1 year
 6007 PC-TRAC Trackball serial 75. bus 85.
 6010 FastTRAP 3D Trackball serial 99. bus 109.
Mouse Systems ... lifetime
 5994 OmniMouse II w/PC Paint Plus . . . 49.
 5845 White Mouse (bus or serial) 69.
 5997 Trackball (1 yr. wrnty) serial 75. bus 85.
 4306 PC Mouse II w/PC Paint+ 89.
NEC ... 2 years
 4799 Multisync 2A (VGA Monitor) 499.
 5085 Multisync 3D Monitor 689.
 6208 Multisync 4D Monitor. 1199.
Orchid Technologies ... 4 years
 3069 Tiny Turbo 286 (accelerator board) 219.
 5105 ProDesigner VGA (800 x 600) 249.
PC Power & Cooling Sys. ... 1 yr
REPLACEMENT POWER SUPPLIES
 3202 Turbo Cool 150 (25° - 40° cooler) 129.
 3205 Turbo Cool 250 (25° - 30° cooler) 169.
 3200 Silencer 150 (84% noise reduction) 115.

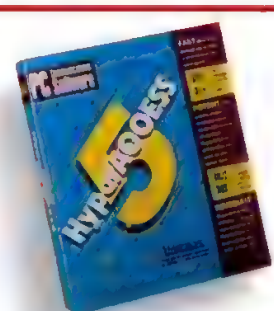


Intel ... 5 years
LAN Sys. Modems—Reliable connections, 100% Hayes compatibility, and a great price
LAN External \$179.
LAN Classic Internal 159.
LAN Modem 2 internal micro channel . 249.

1-800/243-8088

MMC **PC Connection** **680M**
 6 Mill Street
 Marlow, NH 03456
SALES 603/446-7721 FAX 603/446-7791

- Practical Peripherals ... 5 years**
 3101 1200 Baud Internal Modem \$69.
 3100 1200 Baud External Modem (mini) . 77.
 3103 2400 Baud Internal Modem. 139.
 3102 2400 Baud External Modem 179.
 5286 2400 Baud Int. MNP Modem (Lex. 5) 175.
 5285 2400 Baud Ext. MNP Modem (Lex. 5) 209.
 4542 2400 Baud Internal Modem for PS/2. . 229.
 3095 Mini Parallel Print Buffer 32k
 (expandable to 512k) 75.
Safe Power Systems ... 2 years
 4561 Safe 250W (standby power bkup) 249.
 4562 Safe 425W (standby power bkup) 369.



Hilgraeve ... NCP
 • **HyperACCESS 1.2**—“Must-own,” John C. Dvorak. Blasts data through modems faster than any other program. Potent, agile, civilized. Automation breakthrough ... it learns your work! Contains DOS & OS/2 vers. . . . \$115.

- SOTA Technology ... 2 years**
 5107 Floppy Drive Controller (S/P). 99.
 5111 SOTA 286i-12 (12 MHz accelerator) 269.
 5402 SOTA 386i-16 (16 MHz accelerator) 389.
Targus ... lifetime
 4899 Nylon Laptop carrying case 55.
 6037 Premier leather carrying case . . . 199.
TheComplete PC ... 2 years
 5598 TheComplete Half Pg. Scanner 400 189.
 4885 TheComplete Answering Machine 249.
 4887 TheComplete FAX 9600 429.
 5140 TheComplete Page Scanner 549.
 5828 TheComplete Communicator (includes 9600 Baud FAX, voice mail, and 2400 Baud Modem on a single card) 559.
Toshiba ... 1 year
 3684 T1000 Laptop (80C88, 6.4 lbs.) . . . 669.
 4958 T1600 Laptop (12 MHz, 20 Meg) . . . 3249.
Tripp Lite ... 2 years
 6198 Isoblok (2 outlets, direct plug-in) . . 29.
 6199 Isobar 4 (4 outlets, 6 ft. cord) 49.
 6200 Isobar 6 (6 outlets, 6 ft. cord) 59.
 6201 Isobar 8 (8 outlets, 12 ft. cord) 69.
 6202 Isobar 8 Remote (8 outlets) 79.
 6203 Isotel (4 outlets, RJ II protection) . . 59.
 6019 LS 600 Line Stabilizer 85.
 6018 LC 1200 Line Conditioner 159.
Video 7 ... 7 years
 3778 VEGA VGA 219.
 5883 1024i VGA (includes 512k) 289.
 4931 VRAM VEGA 512k 449.

Call right 'til 1.

DRIVES

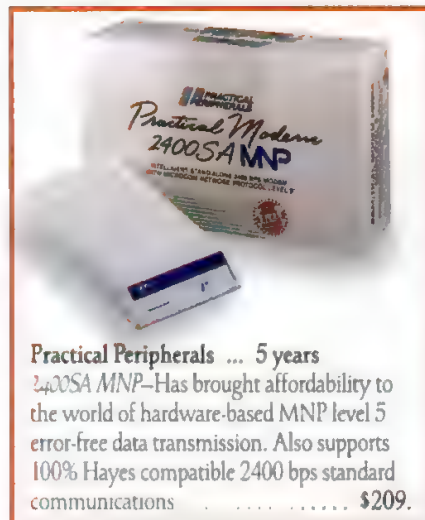
- DTC ... 1 year**
 6248 AT Floppy/Hard Drive Controller (1:1 interleave) ... \$129.
- IOMEGA ... 1 year**
 5116 Bernoulli II Single 44 Meg Internal 995.
 5117 Bernoulli II Dual 44 Meg External 1969.
 5113 44 Meg Cartridge Tripak (5 1/4") ... 249.
 2499 PC2 Card (controller required) ... 169.
 2500 PC2B Card (bootable card) ... 229.
- Mountain Computer ... 1 year**
 2917 40-60 Meg Internal Tape Drive ... 379.
 2935 40-60 Meg Int. Tape Drive for PS/2 379.
 5502 83-152M Ext. Tape Drive ... 759.
 5500 83-152M Int. Tape Drive ... 629.
 6153 DC2120 Cartridge (5 pack) ... 135.
 5190 DC2000 Pre-formatted Cartridges ea. 35.
- Pacific Rim ... 1 year**
 5010 1.2 Meg External ... 215.
 5011 360k External 5 1/4" Drive ... 179.
- Plus Development ... 2 years**
 3105 Hardcard 20 Meg (49 ms) ... 549.
 3106 Hardcard 40 Meg (28 ms) ... 699.
- Seagate ... 1 year**
FREE PCTV® Hard Drive Installation
Tape with purchase of 20, 30 or 40 Meg Seagate drive for the IBM PC (not for AT). Beta or VHS.
 2285 20 Meg Internal Hard Drive ST225 (w/controller and cables, 65 ms) ... 289.
 2286 30 Meg Internal Hard Drive ST238 (w/controller and cables, 65 ms) ... 299.
 4554 40 Meg Int. HD ST251-1 (28 ms) ... 359.
 2287 40 Meg Int. HD for PC ST251-1 (w/controller and cables, 28 ms) ... 429.
 4624 80 Meg Int. HD ST4096 (28 ms) ... 619.
- TEAC ... 1 year**
 4950 PC, XT 360k Drive (5 1/4") ... 79.
 4951 720k Drive (specify XT or AT, 3 1/2") ... 79.
 4670 1.44 Meg Drive for XT (3 1/2") ... 99.
 4326 1.44 Meg Drive for AT (includes Bastech software utilities, 3 1/2" copy prot.) ... 119.

Toshiba ... 1 year

- 3649 AT 1.2 Meg Drive (5 1/4") ... \$99.
 4755 AT 1.44 Meg Drive (3 1/2"), includes Bastech software utilities) 119.

MISCELLANEOUS

- Avery**
 4807 Laser Labels 1" x 2 5/8" (Qty. 3000) ... 24.
 4811 Laser Transparencies 8 1/2" x 11" (Qty. 50) ... 22.
- CompuServe**
 1676 CompuServe Information Service ... 24.
- Cables ... lifetime**
 1019 Smartmodem-to-AT cable (10 feet) ... 15.
 5511 Right Angle Printer cable (6 feet) ... 15.
 1050 Parallel Printer cable (15 feet) ... 19.
- PC Connection ... lifetime**
 5076 2' Table (in oak, teak, or walnut) ... 69.
 1074 3' Table (in oak, teak, or walnut) ... 79.
 5078 4' Table (in oak, teak, or walnut) ... 89.



Practical Peripherals ... 5 years
 2400SA MNP—Has brought affordability to the world of hardware-based MNP level 5 error-free data transmission. Also supports 100% Hayes compatible 2400 bps standard communications ... \$209.

MEMORY

- 3248 256k DRAMs (120 nanosecond) ... call
 4366 1 Meg x 9 SIMMs (100 nanosecond) call
 5510 1 Meg x 9 SIMMs (80 nanosecond) call
 5746 1 Meg Chips (80 nanosecond) ... call

OUR POLICY

- We accept VISA and MASTERCARD only.
- No surcharge added for credit card orders.
- Your card is not charged until we ship.
- If we must ship a partial order, we never charge freight on the shipment(s) that complete the order (in the U.S.).
- No sales tax.
- All U.S. shipments insured; no additional charge.
- APO/FPO orders shipped 1st Class Mail.
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- Upon receipt and approval, personal and company checks now clear the same day for immediate shipment of your order.
- COD max. \$1000. Cash, cashier's check, or money order.
- 120 day limited warranty on all products.*
- To order, call us Monday through Friday 9:00 AM to 1:00 AM, or Saturday 9:00 AM to 5:30 PM. You can call our business offices at 603/446-3383 Monday through Friday 9:00 AM to 5:30 PM.

SHIPPING

Note: Accounts on net terms pay actual shipping.

Continental US:

- For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, pay actual charges. Call for UPS 2nd-Day & Next-Day-Air.
- For all other items, add \$3 per order to cover UPS Shipping. For such items, we automatically use UPS 2nd-Day-Air at no extra charge if you are more than 2 days from us by UPS ground.

Hawaii:

- For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, actual UPS Blue charge will be added. For all other items, add \$3 per order.

Alaska and outside Continental US:

- Call 603/446-3383 for information.



PC Connection ... lifetime
Computer Table—Measuring 2, 3, or 4 feet in width, this desk is the ideal workstation furniture. Rugged laminated table top available in oak, teak or walnut. While supplies last!
 2' Table. \$69. 3' Table. \$79. 4' Table. \$89.

DISKS

All disks have a lifetime warranty.

- 5 1/4" DS/DD Disks (360k)**
 3291 Sony (10 disks per box) ... 12.
 2789 Maxell MD2-D (10 disks per box) ... 13.
 4192 Verbatim Datalife (10 disks per box) ... 13.
- 5 1/4" DS/High Density Disks (1.2 Meg)**
 3770 Verbatim Datalife (10 disks per box) ... 19.
 3292 Sony (10 disks per box) ... 19.
 2790 Maxell MD2-HD (10 disks per box) ... 19.
- 3 1/2" DS/DD Diskettes (720k)**
 3297 Sony (10 disks per box) ... 14.
 3772 Verbatim (10 disks per box) ... 15.
 2792 Maxell (10 disks per box) ... 15.
- 3 1/2" DS/High-Density Diskettes (1.44 Meg)**
 3298 Sony (10 disks per box) ... 29.
 3773 Verbatim (10 disks per box) ... 29.
 2793 Maxell (10 disks per box) ... 29.



Peter Norton ... NCP

- Norton Commander 3.0—New release! Be sure to see the exciting new features. A must for every PC user. ... \$89.
- Norton Utilities Advanced Edition 4.5—Ends the "terror messages" ... 89.

PC CONNECTION®

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PC Celebration.

Furrier & Jive.

(Or, welcome back to the gay nineties.)

People are always asking if the celebrated rural outpost of Marlow, NH (pop. 561, Car. Rt. Sort 03456), is really ready for the '90s. Ready????! Why, if you give us a few minutes to hitch up the horses, light the oil lamps, pop open the parasols, and set a few bonfires, we'll make Currier and Ives look like Bert and Ernie. You see, even though our picture postcard town now has more printers than people, we still know the traditional way to ring out the old and ring in the new.

Oh sure, we've heard the talk about how technology is going to

change everything. But, no matter how many megahertz you muscle into your micro, or how much resolution you ram into your rasters, or how many points per inch you output to print, you can still rely on us to deliver an irresistible combination of down-home prices and up-country personal service.

Better keep our sox on.

It's important that we all keep our tootsies toasty as we stroll down the old stage road into the last decade of the 20th Century. So we're giving a free pair of genuine 100% wool PC Connection Sox to everyone who places an order of \$500 or more between now and March 31.



Enjoy safe sox all winter long with warm and toasty 100% wool PC Connection Sox. Offer not available to accounts on net terms. One per customer.

PC CONNECTION

MONITORS

PAPER-WHITE MONITORS



SUMMARY OF FEATURES: PAPER-WHITE MONITORS

Products listed in ascending price order

	DesignView/19 Elite Business Applications Inc.	OfficePRO II Sampo Corp. of America	Genius ² Model 1920M Micro Display Systems Inc.	Panorama Xerox Corp.	PanaPro M1900 Panasonic Communications and Systems Co.	Monterm Viking 2/81 Moniterm Corp.
DISPLAY BOARD						
VGA compatibility (claimed)	☐	☐	☐	☐	☐	☐
Connectors:						
9-pin	☒	☒	☒	☐	☒	☒
15-pin	☐	☐	☐	☒	☐	☐
Other	None	None	None	None	None	None
Output:						
TTL	☒	☐	☐	☐	☐	☐
Analog	☐	☐	☐	☐	☒	☐
ECL	☐	☒	☒	☒	☐	☒
Maximum resolution						
Graphics (pixels)	1,280 x 1,024	1,280 x 960	1,280 x 1,024	1,152 x 860	1,280 x 960	1,280 x 960
Characters (columns x rows)	160 x 80	160 x 67	160 x 85	144 x 53	160 x 67	160 x 60
Number of gray scales that can be generated	2	2	2	2	2	2
Type of display logic	Discrete	ASIC	Discrete	Proprietary	ASIC	Discrete
Type of display memory	DRAM	VRAM	DRAM	DRAM	VRAM	VRAM
Base video memory on-board	512K	512K	256K	256K	192K	2MB
Graphics coprocessors included	Intel 82786	None	34010	None	None	Hitachi HD63484
Special fonts for particular environments	DOS, GEM, Microsoft Windows	Ventura Publisher	AutoCAD, DOS, GEM, Microsoft Windows, Ventura Publisher	None	GEM, Ventura Publisher	Microsoft Windows, Ventura Publisher
Video ROM version	1.3 (November 1988)	None	3 (February 28, 1989)	Info not available	None	None
Software drivers included:						
Microsoft Windows/286	☒	☒	☒	☒	☒	☒
Microsoft Windows/386	☒	☒	☒	☒	☒	☒
PageMaker	☒	☒	☒	☒	☒	☒
Lotus 1-2-3	☒	☒	☒	☒	☒	☒
GEM	☒	☒	☒	☒	☒	☒
Ventura Publisher	☒	☒	☒	☒	☒	☒
Interleaf	☐	☐	☐	☐	☐	☐
WordPerfect	☒	☒	☒	☒	☒	☒
Microsoft Word	☒	☒	☒	☐	☐	☒
AutoCAD	☒	☒	☒	☒	☒	☒
Others	Publisher's Paintbrush, Publisher's Type Foundry, Symphony	None	Framework, VersaCAD, WordStar	None	AutoShade, Symphony	None
Software utilities available	Diagnostics, video BIOS, utilities to switch between high-resolution graphics and CGA and Hercules	Video BIOS for DOS applications	Mode-setting utility	Setup, diagnostics	Mode-setting utility, video Bios	Diagnostics, video BIOS

☒—Editor's Choice
 ☒—Yes
 ☐—No
 N/A—Not applicable: this monitor uses an 8-bit board

MONITORS

PAPER-WHITE MONITORS

Taxan CrystalView 1901 Taxan USA Corp	Wyse WY-7190 Wyse Technology	Sigma L-View PC Sigma Designs	Monitorm Viking 2/72GS Monitorm Corp.	Ventek AT2000 Ventek Corp.	Monitorm Viking 2400 Monitorm Corp.	DualPage Cornerstone Technology	Image Systems M24L Image Systems Corp
None	BNC	None	BNC	None	None	None	None
1,280 x 960 160 x 67 2	1,280 x 1,024 160 x 66 2	1,664 x 1,200 80 x 25 4	1,024 x 768 128 x 48 16	1,280 x 1,024 160 x 64 64	1,280 x 960 160 x 60 2	1,600 x 1,280 80 x 96 16	1,600 x 1,280 96 x 80 16
Discrete	ASIC	ASIC	ACRTC	Discrete, Paradise PVGA1A	Discrete	Gate-array (proprietary)	ASIC
DRAM	512K DRAM, 256K VRAM	VRAM	VRAM	DRAM	VRAM	VRAM	VRAM
512K	768K	512K	512K	256K	2MB	1MB	1MB
None	TI 34010	None	Hitachi HD63484	None	Hitachi HD63484	None	None
GEM, Ventura Publisher	DOS	GEM, Microsoft Windows	None	None	Microsoft Windows, Ventura Publisher	Ventura Publisher	GEM, Ventura Publisher
3.21C (May 19, 1989)	1.25 (September 1, 1988)	None	None	3.056-005M (May 23, 1988)	None	3.11 (January 26, 1989)	None
AutoShade, Symphony, WordStar	CADvance, P-CAD, VersaCAD	None	None	Generic CAD, OS/2 Presentation Manager, Publisher's Paintbrush, VersaCAD	None	Symphony, WordStar	AutoShade, AutoSketch, Cadkey, Halo '88, PC Paintbrush, Symphony, WordStar
BIOS and text- mode drivers	Setup, text- mode driver	Setup, diagnostics	Software interpreter for applications that write directly to CGA, MDA, and RAM	Diagnostics, mode switching, RAMBIOS, screen capture, screen saver	Diagnostics, video BIOS	Screen-blanking utility, video BIOS	Video BIOS

ENDS

At last! A new HP LaserJet just for you.

At only \$1495*, it's got your name on it.

The HP LaserJet printer family has expanded—in a small way.

The new HP LaserJet IIP (as in Personal) fits right on your desk. And, with a price almost half of the multi-user LaserJet Series II*, into most budgets.

Its simple front panel gives you easy, push-button control over the menu, the 14 internal fonts, form feed and other functions. It handles four different paper sizes: letter, legal, executive and A4, as well as envelopes. In portrait

*Suggested U.S. list prices:
LaserJet IIP \$1495;
LaserJet Series II \$2695.
Dealer prices vary.

HP LaserJet printer family welcomes a small addition.

The new HP LaserJet IIP printer is priced at \$1495*—almost half the cost of the multi-user LaserJet Series II. But with all the family characteristics that have made HP LaserJets so

Their superior text and graphics have helped sell more than a million of them. Success like this has obviously spawned imitators. But none of them can match HP's record for reliability in getting the job done, beautifully and efficiently year in,

year out. We expect the break-through price and status of the new LaserJet IIP to take laser printing where it's never gone before. Right onto the desks of individuals, teams up with PCs all over the world. You'll find the newest member of our LaserJet family quietly humming away at your authorized HP dealer. Showing off, no doubt, the print quality and graphics tracks that will make you want to take one back to the office.



A chip off the old block. The new HP LaserJet IIP printer (front) with the best-selling powerhouse LaserJet Series II.

*Suggested U.S. list price.

or landscape configurations. At four pages a minute. From one or two paper bins (the second is optional).

The 512K standard memory is upgradable to 4.5 Mbytes for more complex graphics and publishing programs.

And, of course, our new printer is compatible with the HP LaserJet Series II and virtually all popular PC software.

So call 1-800-752-0900, Ext. 277J for your nearest authorized HP dealer. Then

introduce people at your company to their very own HP LaserJets.

There is a better way.



**HEWLETT
PACKARD**

CIRCLE 305 ON READER SERVICE CARD

SIGMA DESIGNS

Sigma L-View PC

by Alfred Poor

The Sigma Designs L-View PC carries a \$2,495 list price tag, making it the most expensive system in our review group that could not show at least 16 shades of gray. Yet it does pack some extra value that others don't offer.

One happy detail is that the system comes with plenty of documentation.

Sigma Designs' drivers support graphics modes that run at an impressive 1,664 by 1,200 resolution. This translates to about twice as many pixels as most of the other systems in this review.

There are four separate booklets covering different aspects of the total package: adapter card, monitor, software drivers, and utilities. The system also comes bundled with a private-label version of Z-Soft's *PC Paintbrush* program.

Four driver and utility disks provide a

standard complement of custom display drivers, including *GEM*, *Ventura Publisher*, *Windows* (286 and 386), *Lotus 1-2-3*, and *AutoCAD*. There is no central install program, but the separate driver manual clearly explains how you'll be able to set them up.

Sigma Designs' drivers support graphics modes that are anything but standard; they run at an impressive 1,664 by 1,200 resolution. This translates to about twice as many pixels as most of the other systems in this review. In fact, only two other systems offer a higher resolution.

The images that the L-View PC produces are impressive indeed: crisp and clear. Both *Ventura Publisher* and *Page-Maker* body text was easy to read, even in full-page and facing-page views.

The system component that makes this high-resolution image possible is a substantial adapter card that goes into your computer. Like many of the other cards, the Sigma card has a 16-bit connector that can also work in an 8-bit slot. Like many of the other cards, it requires a full-length slot. Unlike many of the other cards, however, it is a thick sandwich of two full-length boards squeezed together. All the components are in between the two boards so you cannot see them, and the only configuration options are controlled by a set of jumpers that are mounted between the cards along the top edge.

The L-View PC card emulates a Hercules monochrome graphics card, so you do not need to have any other display adapter installed. Your computer will boot right up

with the L-View PC, and if your software supports Hercules, then you can run it with this system. If your program is supported by any of the special drivers, then you can produce the eye-popping high-resolution mode as well.

The 19-inch monitor comes with a tilt-and-swivel base. It also has controls for both brightness and contrast. These controls are present because the system uses a two-plane board, which means that it can produce four levels of gray: black, white, light gray, and dark gray. This capability provides twice as much scale as the straight black-and-white monitors, but frankly it is of little practical use. As a result the L-View PC is best compared with the other two-tone displays.

Oddly, the monitor's cables plug into a recessed area in the back. This poses no major hardship, but you may find it more difficult than average to connect the ca-



FACT FILE

Sigma L-View PC

Sigma Designs, 46501 Landing Pkwy., Fremont, CA 94538; (415) 770-0100.

List Price: \$2,495.

Requires: IBM PC, XT, AT, or compatible; DOS 2.0 or later

In Short: The L-View PC has one of the highest resolutions and good image quality, but its relatively steep price and low benchmark-test scores diminish its appeal compared with some of its competitors.

CIRCLE 427 ON READER SERVICE CARD

bles—though once you plug them in, you probably won't do it again.

Of greater concern is performance—or lack thereof. The Sigma adapter packs half a megabyte of memory, but does not have a graphics coprocessor to help with the load. The DOS benchmark tests clocked in above average, but the high-resolution figures were not as good. The L-View PC finished last in many of the *Windows* and *AutoCAD* tests.

The Sigma L-View PC is well built and produces a good image, but isn't as attractive as some of its competitors. Each of its good points seems counterbalanced by a disappointing characteristic: it does not offer enough gray-scale support to raise it above the black-and-white class of monitors, but its price is as much as 25 percent higher than many machines in that class. It offers impressively high resolution, but its performance figures are disappointing. The result is a machine that is merely adequate—but costs more.

The \$2,495 price tag of Sigma Designs' L-View PC is a bit steep for a non-gray-scale system, but this model's top construction, clear images, and 1,664 by 1,200 resolution account for some of the extra dollars. Unfortunately, its benchmark test performance isn't as impressive as the rest of the L-View's assets.



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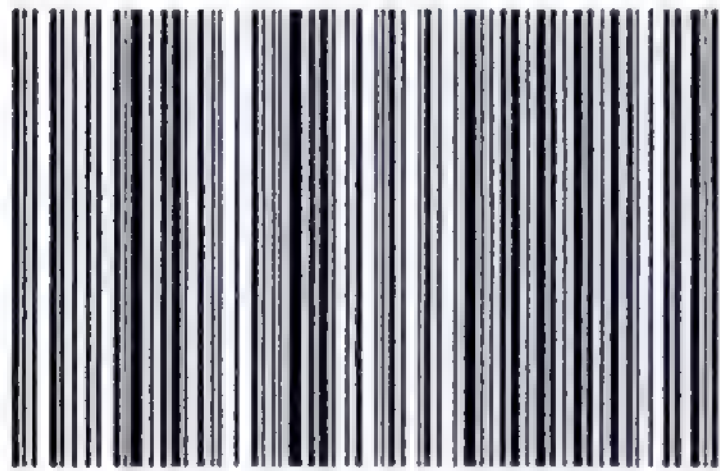
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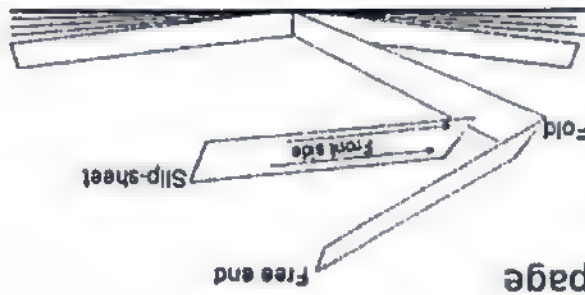
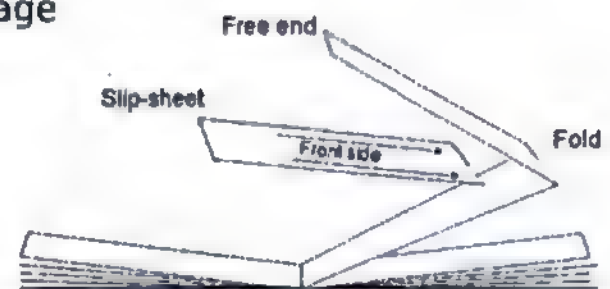
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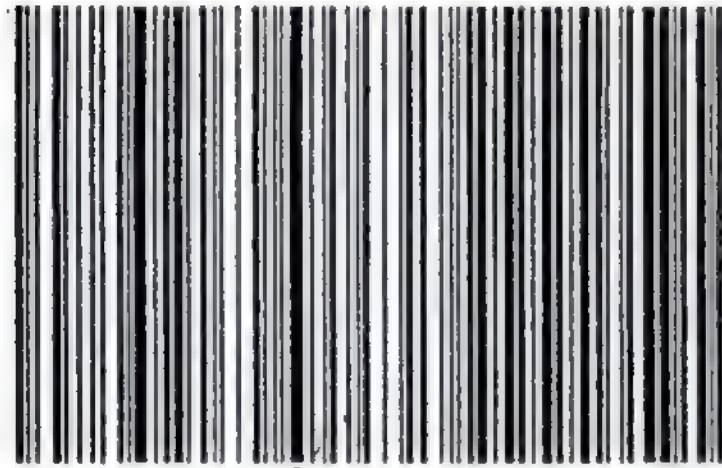
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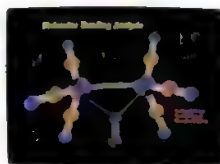
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The COMPAQ DESKPRO 486/25. It's sure to bring a little thunder to your office.

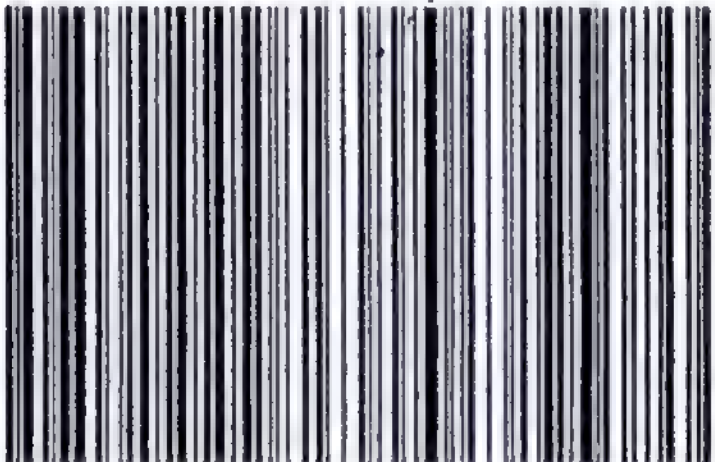


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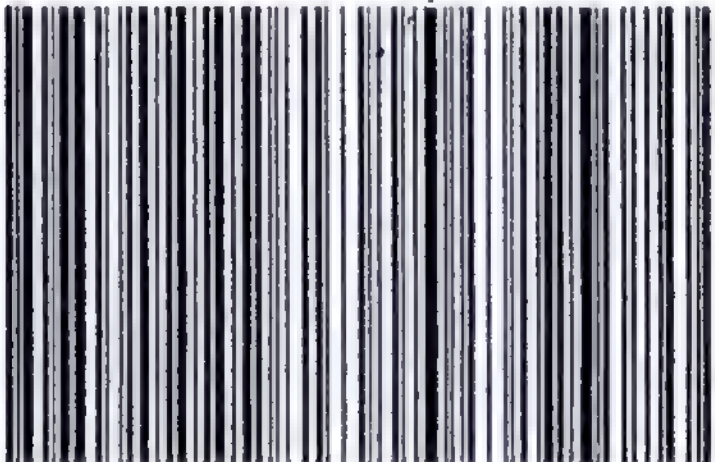
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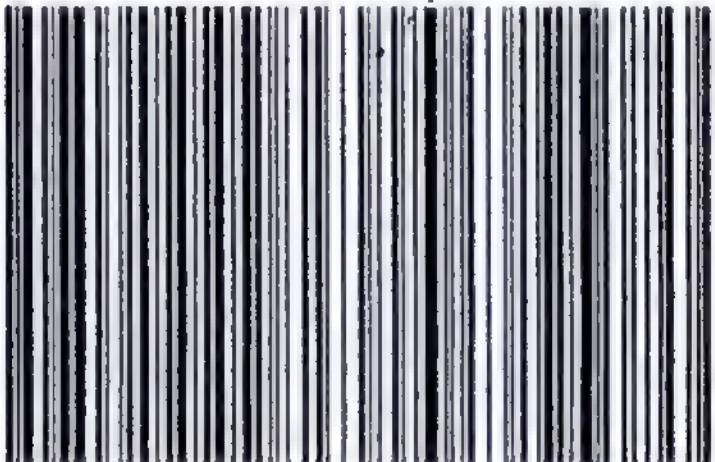
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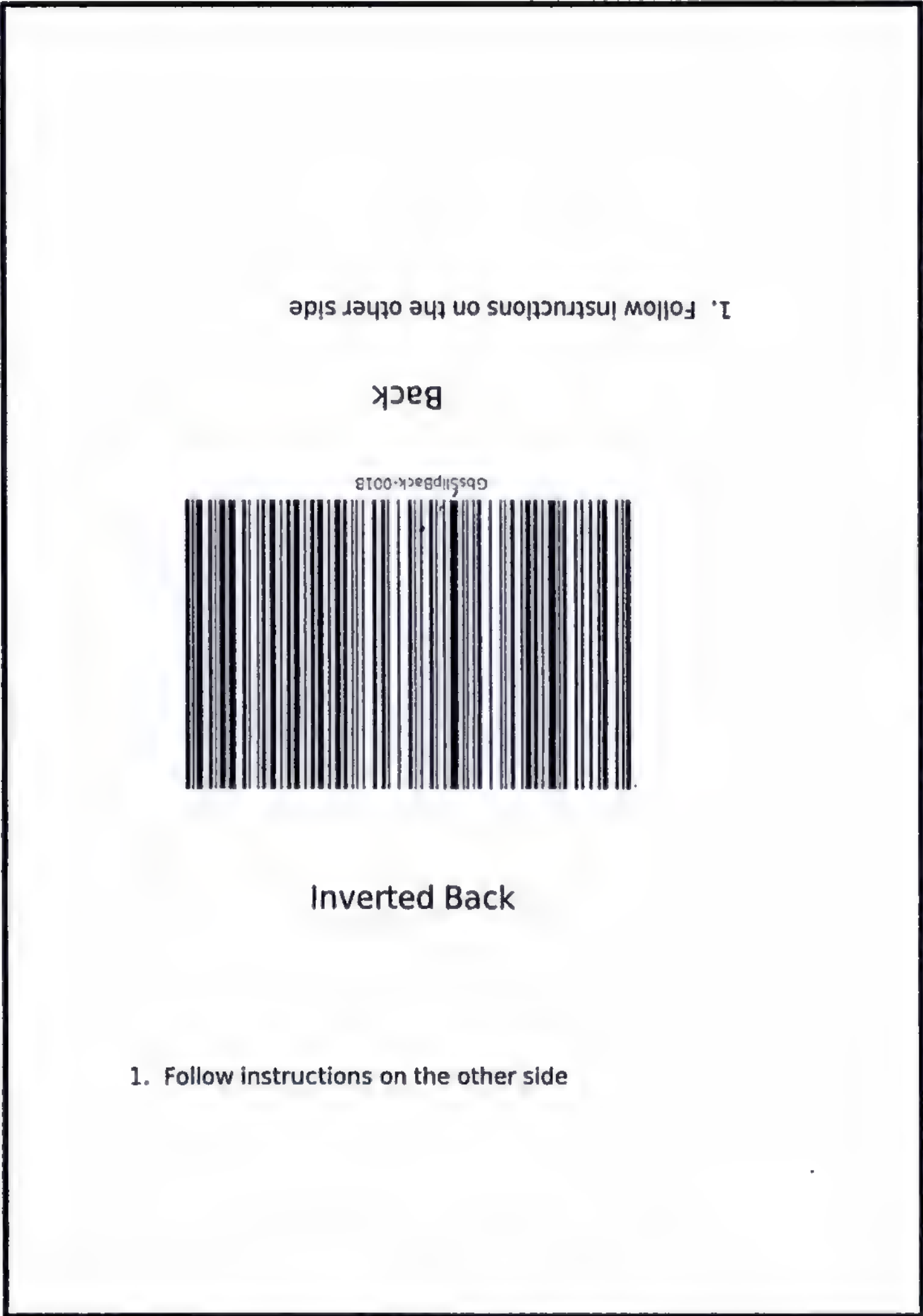
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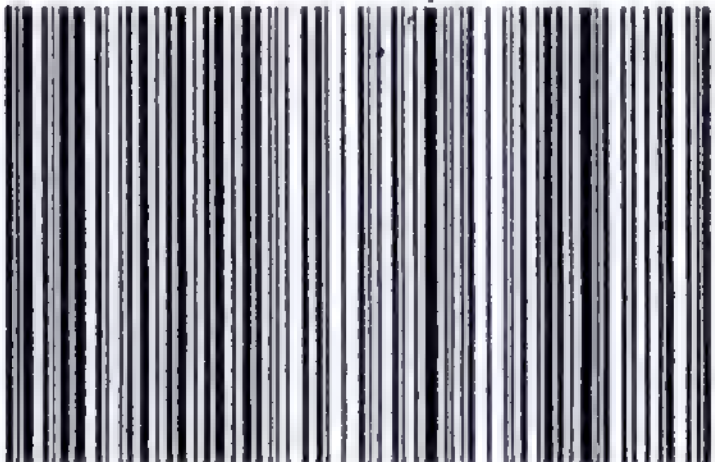
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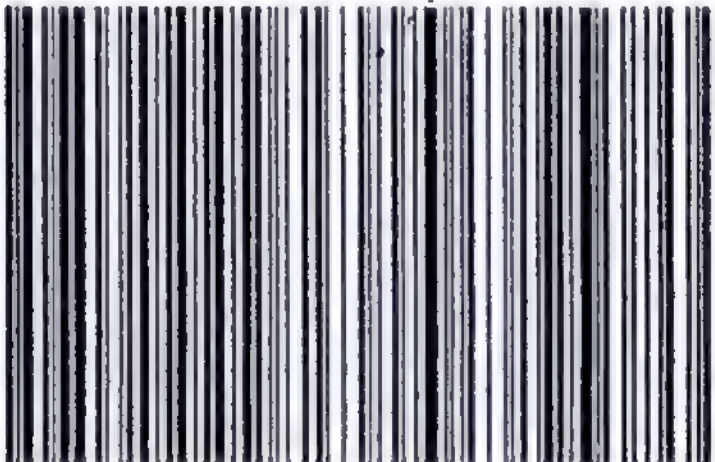
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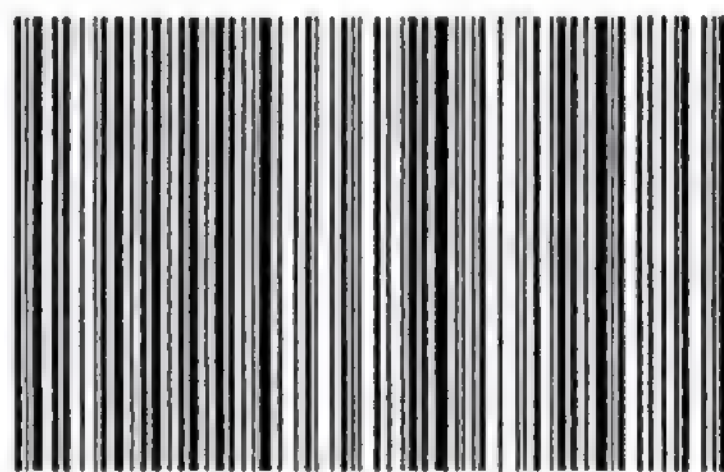
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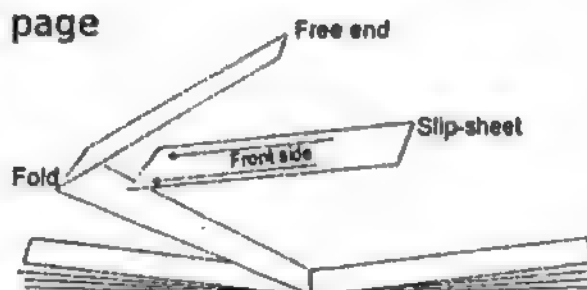


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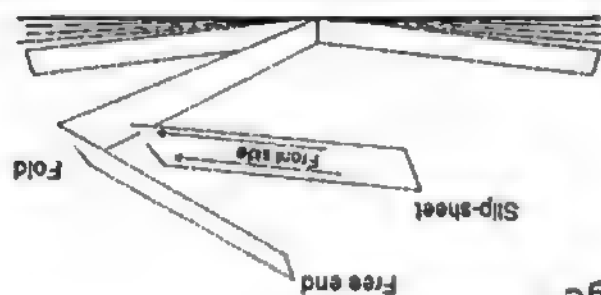
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Compaq intro

As PC technology has evolved, Compaq has been consistently among the first to tap its power. Now with the COMPAQ



DESKPRO 486/25 and the COMPAQ SYSTEMPRO, Compaq brings new levels of performance to single and multiple users.

THE COMPAQ DESKPRO 486/25: THUNDEROUS PERFORMANCE.

For individual power users, nothing compares to the new COMPAQ DESKPRO 486/25 Personal Computer. It will let you work faster than ever before.

Every component has been designed to unleash the power of the new Intel 25-MHz 486 microprocessor. Power that drives numeric-intensive applications up to three times faster than 25-MHz 386-based PCs, outpacing many technical workstations.

It's power you can put to work on the most demanding applications. To handle CAD/CAM/CAE, statistical analysis, portfolio modeling, project management and multitasking.

The Intel 25-MHz 486 microprocessor is the heart of the system. Its breakthrough design integrates the processor with a numeric

coprocessor (to speed number crunching) and an 8-Kbyte cache (to reduce wait states).

To boost performance further, Compaq added a second-level cache memory controller with 128 Kbytes of high-speed static RAM. Combined with interleaved memory architecture, it lets your data fly between the microprocessor and memory.

The 486 works in concert with COMPAQ Flex Architecture, which integrates a processor/memory bus with the new EISA I/O bus. This enables information to be processed at the highest possible speed while maintaining compatibility with 8-, 16- and powerful new 32-bit expansion boards.

The COMPAQ DESKPRO 486/25 is open for customization.

Four megabytes of memory are standard, so you can run applications under MS OS/2 Version 1.2, MS-DOS or UNIX operating systems.

If you need more, you can

expand memory up to 100 megabytes using a separate high-speed 32-bit memory slot. That leaves up to seven EISA slots free for your choice of expansion boards.

You can work with up to seven internal storage devices, choosing from a range of high-performance, high-capacity fixed disk



The COMPAQ DESKPRO 486/25 was designed from the ground up to unleash the power of the 25-MHz 486 microprocessor.

Now for the

In September 1986, Compaq introduced a personal computer that changed people's ideas about what a PC could do.

The COMPAQ DESKPRO 386 Personal Computer was the first PC based on the powerful 386 microprocessor. It gave people the speed and power to do more than ever before. It pushed out the envelope of technology. But did it in a way that let users continue to work with industry-standard software and hardware. With it, Compaq set a new standard in PC performance.

Compaq has done it again.

Introducing the COMPAQ DESKPRO 486/25 Personal Computer and COMPAQ SYSTEMPRO Personal Computer System.

Once again, Compaq has expanded the role of the PC—to meet the most demanding needs of both single and multiple users. And once again, Compaq has pushed out the envelope of technology to deliver new levels of performance and expandability, without sacrificing compatibility.



sonic boom.

These new computers were designed from a simple observation: People use computers differently. One user using a PC has different needs than a group working together on a network or multiuser system.

The COMPAQ DESKPRO 486/25 is for the individual whose job depends on a PC. It was designed from the ground up to unleash the power of the evolutionary new Intel 25-MHz 486 microprocessor.

The COMPAQ SYSTEMPRO delivers an unprecedented combination of system performance and expandability to networks and multiuser systems. Its breakthrough design gives users the flexibility to work with both 33-MHz 386 and future 33-MHz 486 technology. It also provides the unmatched capability to work with multiple processors.

Inside both you'll find advances like cache memory designs that boost processor performance. Extended Industry Standard Architecture (*Extended ISA* or *EISA*) that accelerates input/output performance while maintaining compatibility. New drive and controller technology that increases fixed disk performance and reliability. And that's just the beginning of this story.



Business booming.

Inside, you'll find a series of technological breakthroughs.

The first is a flexible system processor design that lets you work with both 33-MHz 386 and future 33-MHz 486 technology.

Initial models offer a 386/33 system processor that employs a 386 microprocessor optimized with a 64-Kbyte cache memory design and a socket for optional coprocessors. This drives software more than twice as fast as the IBM PS/2 Model 80, and surpasses most minicomputers.

Computing potential can be increased up to four times by adding a second system processor. You can use two 386 processors now. Or work with a 386 and a 486, or two 486 processors in the future. So your investment is protected.

The multiple system processors are integrated into COMPAQ Flex/MP Architecture, which combines a separate processor/memory bus with the EISA I/O bus.

EISA delivers the fastest I/O performance, which is critical for data sharing.

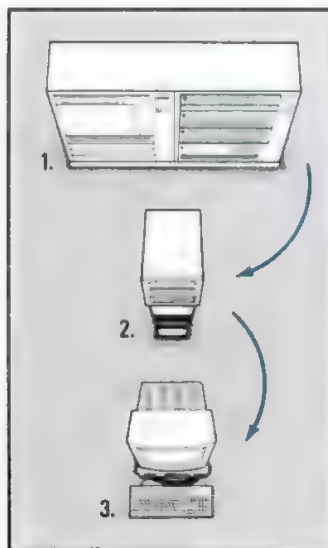
You can add up to six 32-bit network interface controllers for maximum server throughput. And you're ensured compatibility with 8-, 16- and 32-bit boards.

Users gain nearly instant access to fixed

disk data with innovative drive array technology that transfers data up to four times faster than nonarrayed drives. It also supports the most comprehensive range of data protection features.



The COMPAQ LAN MANAGER 386/486 optimizes the COMPAQ SYSTEMPRO for use in OS/2-based networks.



The COMPAQ SYSTEMPRO is a powerful network server and mainframe gateway, giving users the fastest access to departmental and mainframe data.

As you add more users and more complex applications, the COMPAQ SYSTEMPRO grows right along with you. It's the first PC to actually increase in performance when you add options like system processors or drive arrays.

It grows in other ways that are simply amazing. You can expand the 4 megabytes of standard RAM to 256 megabytes, use up to 11 expansion boards, work with 11 storage options

and store up to 4.28 gigabytes of data.

You're also free to work in your choice of network and multiuser operating system. This includes Novell NetWare 386, SCO UNIX System V/386, new COMPAQ LAN MANAGER 386/486 and others.

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In every COMPAQ personal computer you'll find innovative technology. Along with plenty of common sense. Like the ability to run the world's largest library of industry-standard software. And the room to add the peripherals your job demands.

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TAXAN USA CORP.

Taxan CrystalView 1901

by Alfred Poor

The CrystalView 1901 is a 19-inch system that lists for \$2,195, an average price for a large black-and-white display. You will find that most of the CrystalView's other features are middle-of-the-road, too.

In this case, average is anything but a synonym for mediocre. The CrystalView displays an image with 1,280 by 960 resolution, which results in nearly 1.25 million individual pixels. The system does not offer gray-scale support, but the screen display is crisp and clean.

Part of the quality is attributable to the controller, which is made for Taxan by Cornerstone. It is similar to some of the other Cornerstone cards reviewed elsewhere in this article. The card has a 16-bit edge connector but it can work in an 8-bit slot if necessary. It carries a half-megabyte of memory, but does not have the support of a graphics coprocessor on board.

The adapter card is capable of emulating a Hercules monochrome graphics display adapter, and you can run your system comfortably without another adapter and monitor installed. Set your computer to recognize a monochrome monitor and it will boot right up with only the CrystalView plugged in.

The board also comes with drivers for about as many applications as you will find with any of the other products listed here.



FACT FILE

Taxan CrystalView 1901

Taxan USA Corp., 161 Nortech Pkwy., San Jose, CA 95134; (800) 544-3888, (408) 946-3400.
List Price: \$2,195.

Requires: IBM AT, XT, PS/2 Model 25 or 30, or compatible; 8- or 16-bit slot.

In Short: The CrystalView is a good system with average resolution, average performance, and an average price. Better values are available, but in other respects you will not be disappointed with this choice.

CIRCLE 428 ON READER SERVICE CARD

Installation is relatively easy, since most of the steps are managed by a central installation program provided by Cornerstone. The system also knows how to take advantage of the third-party driver disk feature with *Microsoft Windows*'s SETUP, so you do not have to waste time creating a separate SETUP disk.

The monitor itself is housed in the same case as a number of the other systems we've reviewed in this issue. It has a tilt-and-swivel base and easy-to-reach power and brightness controls on the right side.

Perhaps the most significant average feature was the CrystalView's benchmark test performance. It did fairly well in the DOS video tests, but in this respect it was no different from the other Cornerstone-based products. It was second-fastest on the *AutoCAD* test, but this is unremarkable since most of the field was separated by less than a 10 percent difference. The *Windows* times were squarely in the middle of the group for many of the tests.

The CrystalView is an unremarkable entry in a broad field—it performs adequately, projects a good image, and it even comes at a good price. If there were no other choices available, it would be an excellent choice. However, there are competitors in this review that offer better speed, better prices, and better resolution, and therefore make better overall choices.

VENTEK CORP.

Ventek AT2000

by Alfred Poor

The Ventek AT2000 stands apart from the rest in the field in more ways than one. The \$2,695 list price does not even hint at the range of features belonging to this system. And some of these extras even improve the value of the total package.

The package is built around a 20-inch monitor with a tilt-and-swivel base. This

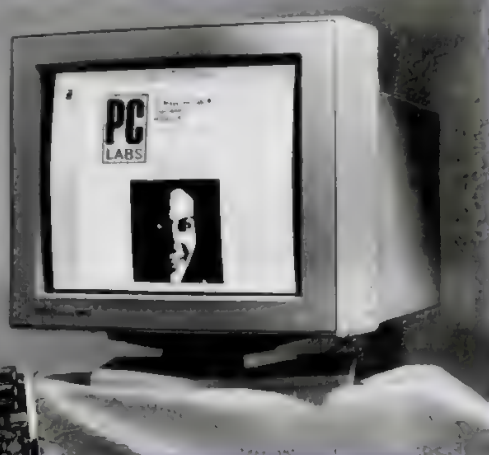
**In addition to
producing high-
resolution images on a
good-looking screen,
the AT2000 handles 64
shades of gray.
In fact, it's the only
board-and-monitor
unit tested that can.**

unit has a fixed horizontal frequency for 1,280 pixels but is able to accommodate vertical frequencies for 960 to 1,024 non-interlaced vertical pixels. The screen itself looks like attractively textured paper; while most white phosphors are mixes of yellow and light blue, the Ventek includes tiny flecks of black.

In addition to producing high-resolution images on a good-looking screen, the AT2000 system can support gray scales. In fact, it is the only board-and-monitor combination tested here that can handle 64 shades of gray.

The board has another interesting feature—VGA. A Paradise chip resides right on the card, and you can hook up both the

The Taxan CrystalView 1901 offers midrange construction, performance, and resolution at the midrange price of \$2,195. Graphics and text are clean, and installation is easy, making the CrystalView a smart (if unexceptional) choice.



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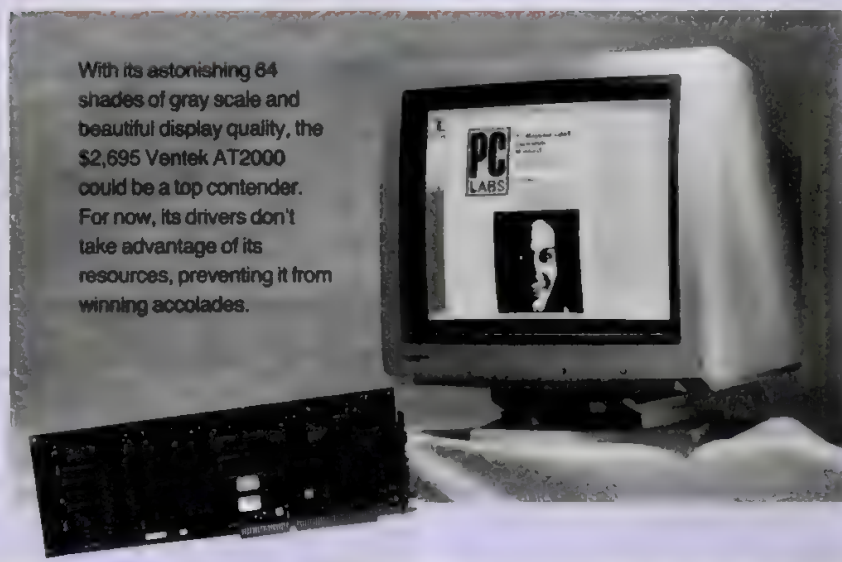
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MONITOR PAPER-WHITE MONITORS



With its astonishing 64 shades of gray scale and beautiful display quality, the \$2,695 Ventek AT2000 could be a top contender. For now, its drivers don't take advantage of its resources, preventing it from winning accolades.

large monochrome monitor and a regular VGA screen to the card simultaneously. Your regular applications will run normally on the VGA screen, but you can use the special drivers to run certain programs on the large screen in high-resolution mode.

Here's the rub, however. Unfortunately, the drivers handicap what might otherwise be an outstanding system. All the drivers use the 1,280 by 960 mode instead of taking advantage of the higher vertical resolution that the system supports. More serious is the fact that the *Microsoft Windows*, *Ventura Publisher*, and *AutoCAD* drivers do not support the gray-scale feature. Since these are the programs that you are most likely to use with the system, its inability to take advantage of gray-scaling techniques for these packages seems like a tragic waste. The system will display gray scales in VGA mode, but you should not have to give up resolution to get shades.

Aside from the lack of gray-scale support, the drivers do a good job. The body text on full-page or facing-page displays with *Ventura* and *PageMaker* was not only clear and easy to read but was a bit better than average. And the images produced were crisp and attractive.

The AT2000 turned in some of the best times on the DOS benchmark tests, but perhaps that was partly because they ran on the separate VGA monitor. The *AutoCAD* results were a shade faster than average, but the entire field was close, so this was no major victory. In the *Windows* tests, however, the Ventek Monitor finished last or next to last in many of the timings. Its

adapter has no graphics coprocessor, which may explain some of these slow results.

Installation is fairly easy. The 16-bit card can operate in an 8-bit slot if necessary. It can configure itself automatically, or you can force 8-bit operation via a DIP switch. There are remarkably few configuration options available on the adapter card, but the factory settings worked fine the first time.

The drivers come in separate subdirectories on the utility disks, and there is no central installation program. Unfortunately, not even the manual provides instructions for the drivers; you must refer to the README files in each subdirectory for installation details. This is not an awful limitation, since you will probably have to deal with it only once, but it certainly is not

PC FACT FILE

Ventek AT2000

Ventek Corp., 31336 Via Colinas, #102,
Westlake Village, CA 91362; (818) 991-3868.

List Price: \$2,695.

Requires: IBM XT, AT, or compatible; 8- or 16-bit slot.

In Short: With a bargain price for a 64-shade gray-scale system, the Ventek AT2000 also includes a VGA adapter on board and has an excellent screen. Unfortunately, the system does not include gray-scale drivers for *Ventura Publisher* or *Microsoft Windows*, nor does it take full advantage of its own resolution. With improved drivers, this could be a best-of-its-class machine.

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PC EDITOR'S MAGAZINE CHOICE

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MONITORS PAPER-WHITE MONITORS

as handy as the automated procedures offered by other systems.

In spite of its gray-scale potential, the Ventek AT2000 must be judged as a black-and-white system. Without high-resolution drivers that take advantage of this feature, it becomes an expensive two-tone system. On the other hand, the integral VGA adapter is a useful plus. Therefore it must rank as a near miss; with the addition of sophisticated gray-scale drivers it will be a great value, but not until then.

WYSE TECHNOLOGY

Wyse WY-7190

by Alfred Poor

If you're shopping for a black-and-white, large-format display system, you may expect to have to choose between different features: performance versus affordable price, resolution versus application support, and so on. If you don't want to give up any of these features to get another, there is a solution: the Wyse WY-7190.

With a list price of \$2,195, the WY-7190 is not among the lowest-priced systems in the field, but it is not among the highest either. When you look at its features and performance, this slightly higher-than-average price appears quite justifiable.

One important reason for this resides on the adapter board: a TI 34010 graphics co-

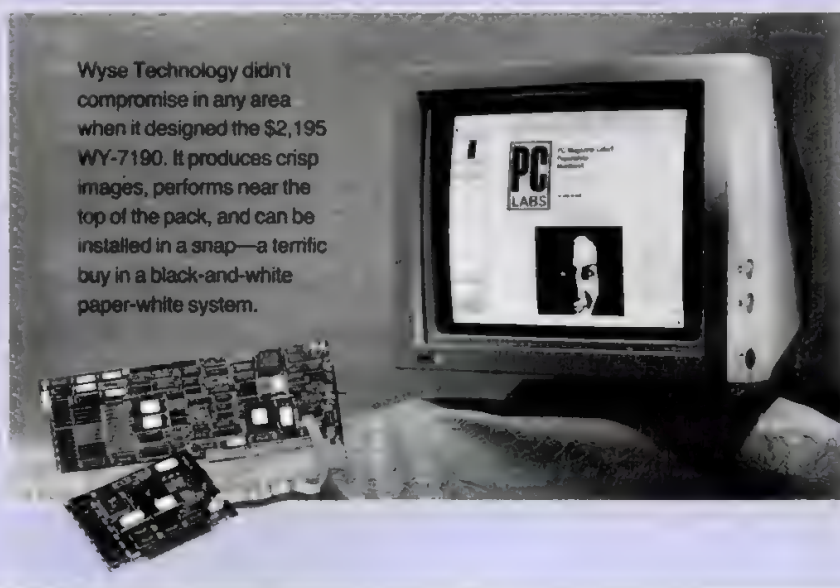
processor. This programmable chip can take over a significant portion of the display-processing tasks, leaving your system's CPU more cycles to do other tasks. Wyse backs this up with 256K of video RAM (VRAM) and another half-megabyte of dynamic RAM (DRAM).

All of these assets are included on an expansion card with a 16-bit edge connector. One important note: Unlike most other 16-bit display cards in this review group, the Wyse will not work in an 8-bit slot. As a result, this system cannot be installed in a PC or XT, and you will need an AT or compatible system.

The board is easy to configure using the single set of eight DIP switches. Chances are excellent that you will be able to use the card with its factory settings, but if necessary you can change a variety of settings requiring different emulations and alter-

**Only three systems in
this test had more
pixels than the
WY-7190's 1.3 million,
and they were all
gray-scale systems.**

nate memory addresses. The card will co-exist with other display cards, and Wyse even offers a special VGA adapter for the system. Happily, you will probably not need another adapter at all, because the



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card can emulate both Hercules monochrome and CGA modes by itself.

The WY-7190 comes with a good collection of drivers for popular applications. About the only one missing is the *Microsoft Windows/386* driver, but there are plenty of others, such as *WordPerfect*, *Microsoft Word*, and a variety of CAD programs, including *AutoCAD*. Unfortunately, the driver disk does not include a utility to help automate the installation process, but each application has a different directory on the disk with its own *README* files containing instructions. This makes for a little more installation work than with some of the other systems. But since you only have to go through this process once, it looms small on the problem scale.

The monitor comes with its own tilt-and-swivel base, and it connects to the card with a coaxial cable instead of the more common multipin connectors. The monitor can display 1,280 by 1,024 resolution images, which amount to more than 1.3 million pixels. Only three systems in this test had more, and they were all gray-scale systems.

The WY-7190's images were crisp and

MONITORS PAPER-WHITE MONITORS



FACT FILE

EDITOR'S CHOICE

Wyse WY-7190

Wyse Technology, 3471 North First St., San Jose, CA 95134; (800) GET-WYSE.
List Price: \$2,195.

Requires: IBM AT or compatible, 16-bit slot.
In Short: The Wyse requires a 16-bit slot but offers an exceptional combination of resolution, performance, design, and price. Altogether, it is the best value of the bunch for a black-and-white system.

CIRCLE 546 ON READER SERVICE CARD

clear, and the text on the *PageMaker* dual-page display was easy to read. Our only minor complaint focuses on the *Ventura Publisher* driver: the scroll and menu bars are too wide. They appear to have been simply scaled up from the standard display, rather than made smaller, as is possible with high-resolution displays.

The benchmark test results were good. The WY-7190 was the fastest of all the monitor/card systems in most of the *Windows* tests and did well in the *AutoCAD* timing. Only the DOS video scores were

slower, and even those were mixed.

One of the reasons for the fast *Windows* times is the 34010 graphics coprocessor. The card has a red LED that glows when the processor is working. While this diagnostic is helpful only when you have the top off your computer, it did show us that the card took much of the processing load during the *Windows* tests.

The Wyse WY-7190 presents an excellent image and a terrific value. High speed, high resolution, and solid design at a reasonable price all add up to an unusually good purchase. If you're looking for a large black-and-white display system, this impressive entry is hard to top.

XEROX CORP.

Panorama

by Alfred Poor

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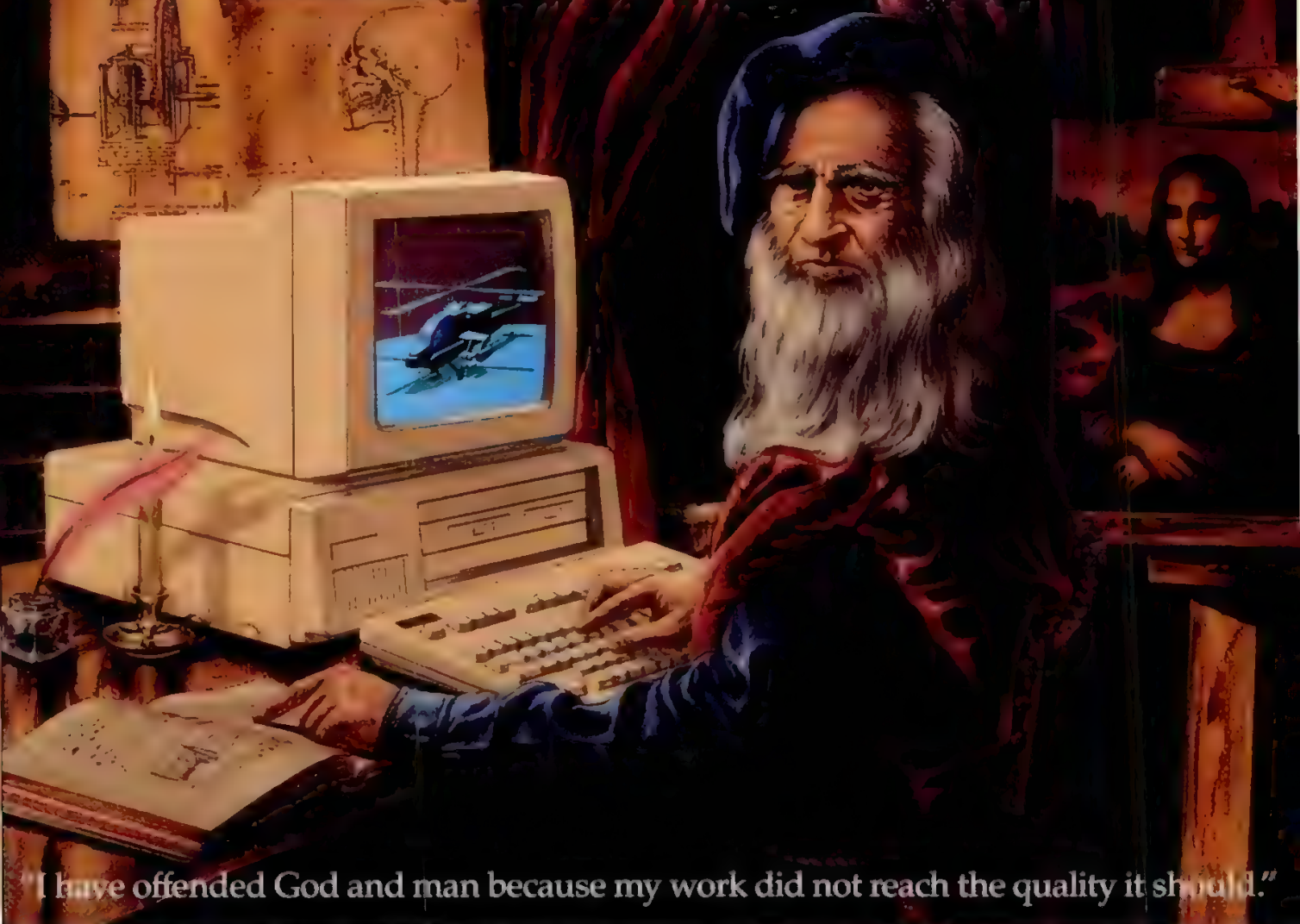
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No. 24

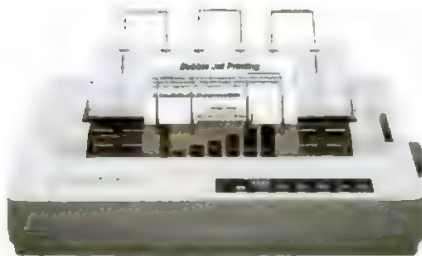


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MONITORS PAPER-WHITE MONITORS

Xerox Corp.'s Panorama has an attractive list price of \$1,995 but produces a resolution of only 1,152 by 860. Flicker is evident in the display, and text can be difficult to read. Combine these problems with poor test performance and the Panorama loses its allure.



You can rightly expect great things from Xerox's Panorama large-format monochrome display system.

One aspect you probably won't expect is the price. The Panorama's list price is just \$1,995—making it one of the four sys-

tems tested here that manages to break the \$2,000 price barrier. There are a handful of other surprises in store for the user, but unfortunately, most of them are disappointments.

The monitor's high-resolution mode is

rated at 1,152 by 860. The only other system with less than a million-pixel resolution was a gray-scale monitor, but the Panorama lacks the same excuse because it produces images in black and white only. To make matters worse, the display is interlaced. As a result, there is an obvious flicker in the high-resolution mode. The flicker is not as bad with the Ventura driver, but it is extremely pronounced under Windows.

The adapter card is made for Xerox by Sigma Designs, as are the accompanying drivers and utility programs. Like the Sig-



FACT FILE

Panorama

Xerox Corp., 1960 East Grand Ave., El Segundo, CA 90245; (213) 333-8718.

List Price: \$1,995.

Requires: IBM PC, XT, AT or compatible; DOS 2.10 or later; full-length expansion slot.

In Short: The Xerox name and low list price may get your attention, but the Panorama's low resolution, poor images, interlaced display, and mediocre performance should be enough to deflect your interest to some other system.

CIRCLE 547 ON READER SERVICE CARD

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CIRCLE 110 ON READER SERVICE CARD

MONITORS PAPER-WHITE MONITORS

ma L-View adapter, the adapter card is a full-length sandwich of two boards that fit into a single slot. It also emulates the Hercules monochrome and CGA, so you won't need a second adapter and monitor. But the Xerox card is fundamentally different because it has only an 8-bit edge connector.

The system's benchmark test results were mixed. Its DOS timings were fair to poor. Under Windows, its best times were

in the middle of the pack. And while the AutoCAD results were fairly flat across the board, it still found itself in the second half of the group.

Perhaps you could forgive the weak timings if you got outstanding images instead, but no such luck. In PageMaker, the body text on a two-page display was legible but difficult to read. In Ventura, the



EDITOR'S CHOICE

- DualPage
- Wyse WY-7190

Comerstone Technology's DualPage is clearly the winner among the gray-scale monitor/card systems reviewed here. The DualPage costs a little more than some of the other gray-scale competitors, but it is the most cost-effective choice. It has a better monitor than the Image Systems M24L and is easier to install and use than the Moniterm monitors. While the Ventek AT2000 offers more gray levels, it lacks drivers that make use of this feature at resolutions higher than standard VGA. One of the diamonds in the DualPage's tiara is its Ventura Publisher drivers, which include anti-aliasing fonts that make text even easier to read.

If your CAD or DTP requirements allow you to settle on a black-and-white unit that does not produce gray scales, you should look at the Wyse WY-7190. The on-board graphics coprocessor gives it a performance boost, yet the system carries an aggressively low list price. It produces excellent images and is straightforward to install and use. Other systems may top it in one aspect or another, but it represents the best combination.



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CIRCLE 290 ON READER SERVICE CARD

body text could not be read at all on a full-page display.

According to a Xerox representative, the Panorama is a product without a future. While it remains a part of the Xerox line, it will do so only until the current supply is exhausted. There are no plans at present to make more.

Just as well: the Panorama's low resolution, poor image, interlaced display, and relatively slow performance are too much of a handicap for the otherwise attractive brand name and aggressive price. Whatever cash you save on this monitor you will probably end up spending on corrective lenses. ■

Kellyn S. Betts is an editor at Gower Medical Publishing and a former associate editor of PC Magazine. Alfred Poor and Winn L. Rosch are contributing editors of PC Magazine.

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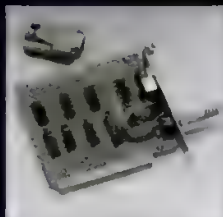
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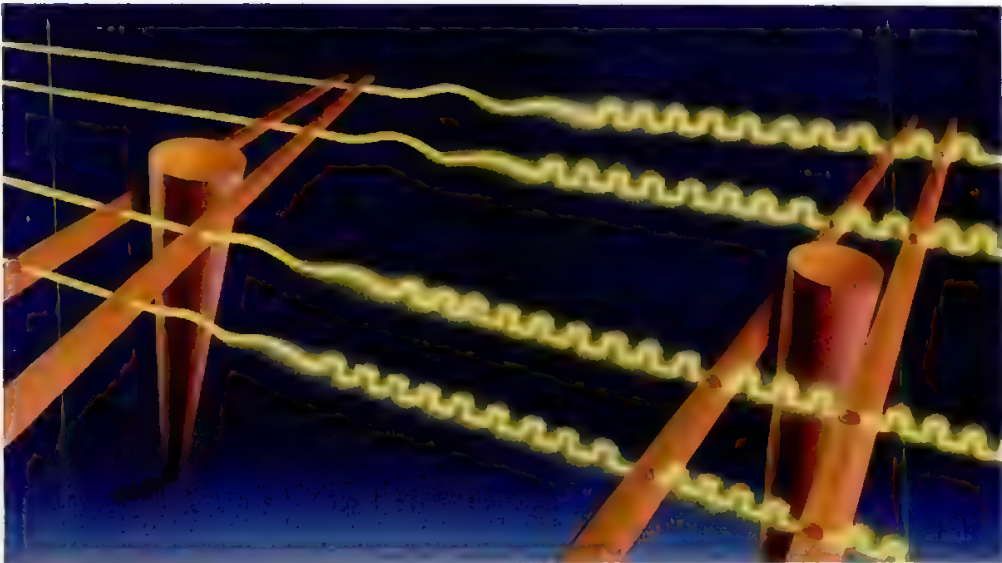
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It's backed by billions of dollars, managed by thousands of people, and has the potential to reach into every home and office in North America. No, it's not the space program. No, not health research. Social security? Wrong again.

We're talking about ISDN: Integrated Services Digital Network, one of the best-funded and broadest-reaching programs to come out of the high-technology industry. The goal of the program is to link every home and organizational desktop with high-speed digital data services carried over telephone wires. This technology has the potential to influence how people in Western Europe, Japan, and North America work, study, communicate, and conduct commerce.

The banners waving on the front lines of ISDN carry the colors of some of the largest international corporations in the world, including AT&T, NCR, Siemens, Hitachi, Northern Telecom, government-controlled telephone monopolies, and every U.S. Regional Bell Operating Company (RBOC). The market for end-user equipment alone is estimated at over \$5 billion in 1994

**The digital phone system
of the future has the
potential to change the way
we think about LANs.**

by Frank J. Derfler, Jr.

(*Electronic News*, July 10, 1989). The cost of switches and services will add billions more annually.

Today, ISDN is most important to you if your organization is centered around Chicago; Houston; Atlanta; Washington D.C.; Sunnyvale, California; Huntsville, Alabama; Boston; St. Louis; and many cities served by US West. Service is available in other areas, but these are 1990's ISDN "hot spots."

Of the Regional Bell Operating Companies, US West, Ameritech, Bell South, and Southwestern Bell have taken leadership positions in ISDN. You can order ISDN service from US West in Olympia, Washington, and Great Falls, Montana, but you'll have a hard time getting ISDN service from NYNEX in New York City, except in a few neighborhoods. Still, all of the Bell Operating Companies have made a commitment to ISDN, and the number of service areas grows every month.

The need to equip the computerized switches of the long-distance telephone carriers with sophisticated software to pass ISDN calls currently limits national and international ISDN services. Pressure from the increasing number of users of ISDN services and the RBOCs should make national service practical within 12 months.

THE FUTURE OF THE PHONE

ISDN is an international program that sets standards for the complete digitization of the telephone systems in Western Europe, Japan, and North America. The plan calls for converting the present analog signaling

circuits and systems to digital circuits and systems that will circulate zeros and ones instead of analog voice frequencies.

This process isn't as radical as it sounds. Modern phone systems are already mostly digital. When you hit the buttons on a phone using tone dialing, you program a sophisticated computer in the telephone company's central office, telling it to connect your phone to the desired destination. Your local telephone company's central office computer communicates digitally with computers from other companies both nationally and internationally to move your voice.

Digital computer-based telephone switches are the rule in most communities in North America. Many organizations have PBXs that convert analog voices to digital zeros and ones right in the telephone. Many of us use all-digital phone systems already.

If so many all-digital phone systems are in use, why must we use modems to change the PC's digital signals to analog tones for transmission over telephone lines? The answer is that modern telephone systems are modern only up to the dial central office. En route from the dial central office to homes and businesses, phone lines drop back to technology that Alexander Graham Bell would recognize in an instant.

This local wiring, called the "local loop," was designed for analog telephones and signals. Special line cards in the dial

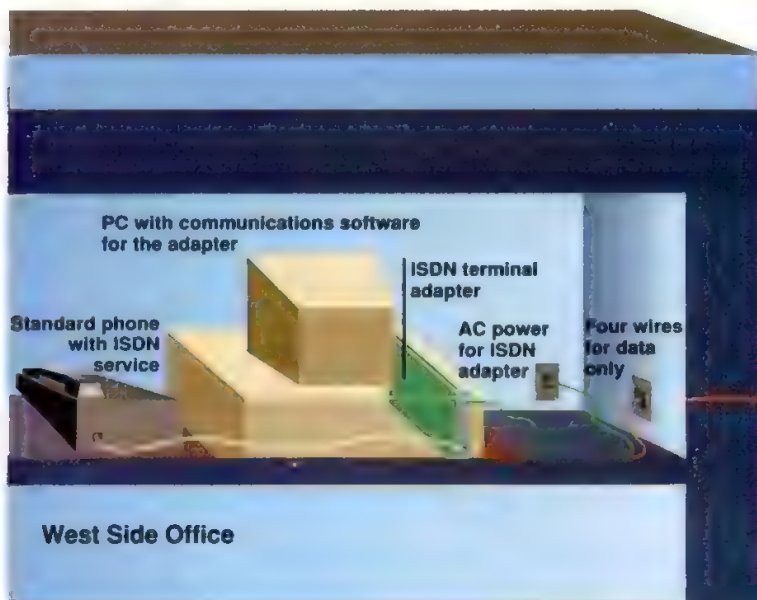
ISDN TOPOLOGY



The rule of thumb for data communications is that local connections are fast while long-distance connections are slow. ISDN breaks that rule by providing long-distance connections with 10 to 12 times the throughput of other, similar services with similar costs.

The value of ISDN to PC users lies in its ability to carry data at high speed across town and country. With appropriate software, ISDN-equipped PCs can act as remote LAN client stations, making high-speed attachments to mainframes and sharing resources like databases and printers over long distances.

Telephone company dial central office ISDN switch



PCs can receive ISDN services from local PBXs or from telephone company dial central offices. The basic rate service line uses two 64-kilobit-per-second channels for data related to applications and one 16-kbps channel for control of the communications process.

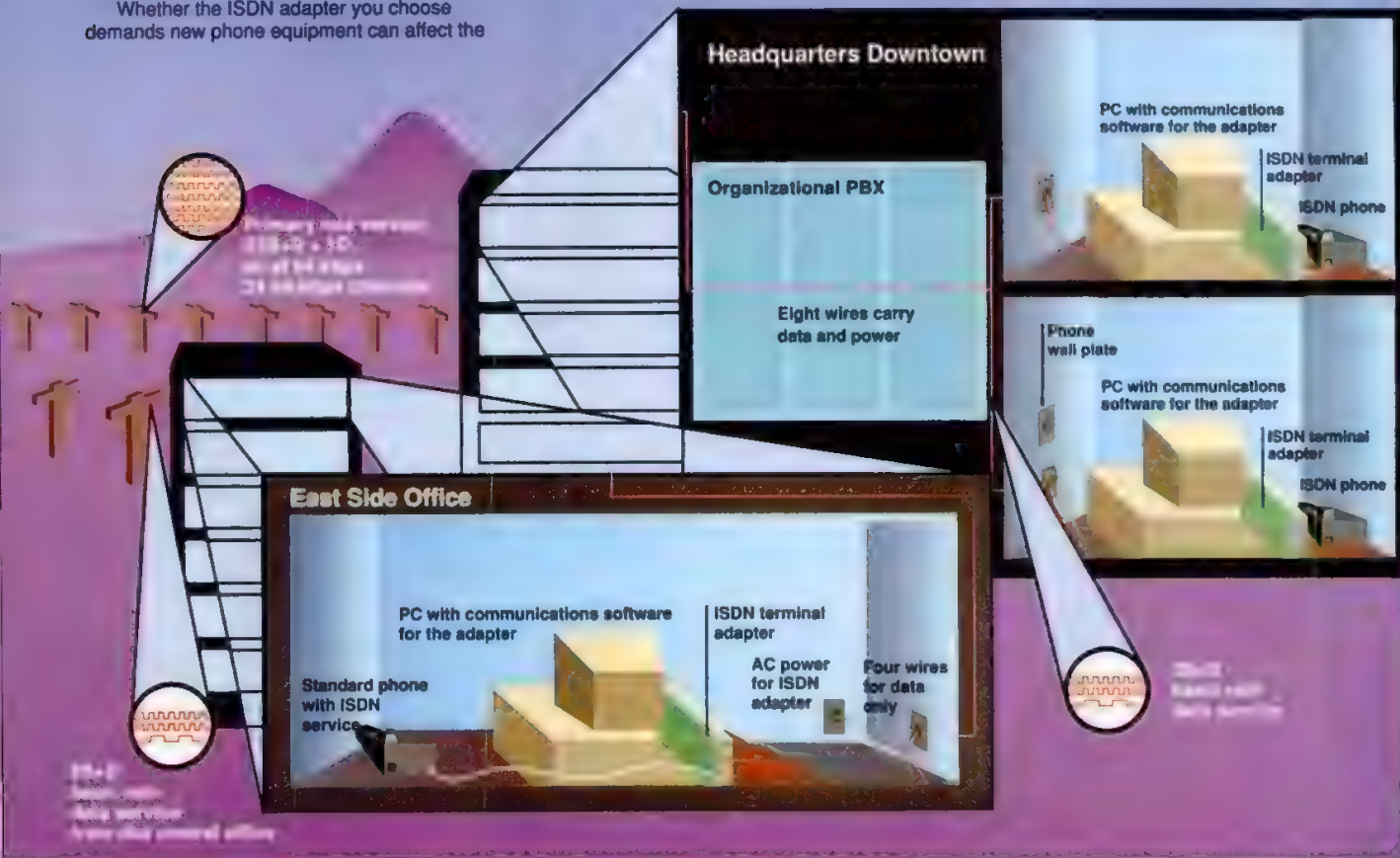
ISDN switches, such as PBXs and central offices (COs), communicate over a "primary rate" service line that operates at 1.544 megabits per second; it uses 23 channels for applications and one channel for communications control.

Whether the ISDN adapter you choose demands new phone equipment can affect the

overall system cost dramatically. Some adapters let an inexpensive analog phone communicate over ISDN by using the PC's screen to display special ISDN functions. Other adapters require an ISDN instrument.

In large organizational installations, power for the adapter comes from a reliable central source through the telephone cable. In smaller installations, a wall transformer supplies power to the adapter. With this design, if the power goes out, so does the telephone service.

Currently all of the adapters in this diagram must come from one vendor, but companies are trying to develop products that can intercommunicate over the data channel no matter who made them. Standard software interfaces for applications and standard formats for exchanging data over data channels will be two of the keys to the success of ISDN.



central office telephone switch translate between the digital signals in the switch and the analog signals in the phone line. You must convert your PC's new-tech digital signals into old-tech audio tones with a modem so that they can be converted back to digital signals, in different form, at the switch.

Most of the noise you hear on a telephone call comes from the analog local loops on each end. Make these local loops digital, and the noise disappears. Of course, the square digital waves get clipped and distorted, but you can fix digital signal problems by regenerating them at intermediate stops. Analog noise is additive throughout the system.

REALITIES OF CONVERSION

Using digital local loops means that you need digital phones at each end. Does that mean you have to throw out your existing phones to use ISDN? Probably. You could use an adapter to integrate an old-style analog phone into ISDN service, but you would miss the convenience of the ISDN services detailed later in this article. But even on a digital local loop, your PC needs a modem-like adapter to use ISDN. The unique signaling scheme and voltage levels of ISDN create the need for a digital-to-digital ISDN adapter in each PC.

There's more. When your phone is digital, it needs a source of local power. If you don't have a backup power source for the

phone, when the lights go out, so does the phone service.

When you make the local loops digital, you eliminate the bandwidth problems that force us to use sophisticated and high-priced computer-controlled modems to move data at anything over 300 bits per second. Using data compression and sophisticated signaling techniques, modem modems advertise throughputs of up to 18 or 20 kilobits per second (one way) over dial-up lines, but not with every file and certainly not with everybody's modem. If you make the local loop digital, you can easily send over 140-kbps (two ways) over the telephone lines.

Sometimes it's easy to make the local

loops digital, and sometimes it's a tough trick. If an area (home or office) is within 6 to 10 miles of the dial central office, as in most cities and towns, copper cables link that area with the central office. Copper cables can carry high-speed data, but at present, devices called *loading coils* that reduce distortion on the analog signals make it impossible to send digital signals over the copper cables. Converting the cabling to digital signaling can be as easy as clipping off the loading coils.

But for premises farther away from the dial central office, engineers use other techniques, including radio repeaters, to carry the voice signals. These repeaters don't have digital capabilities and are expensive to replace.

For these and other reasons, ISDN will grow first in cities and new communities installing telephone systems for the first time. Since the initial market for ISDN services comes from organizations in the cities, the availability of and demand for service should grow hand-in-hand.

WHO IS CALLING?

ISDN has much to offer the average telephone user besides high-quality voice calls. The telephone industry's favorite plug is the system's ability to let ISDN users know who is calling before they answer the phone.

Because an ISDN telephone call is digital, the phones and switches can pass a lot of information about the call. A key ISDN buzzword is ICLID, or incoming call ID. The ICLID message goes from the ISDN switch used by the calling phone to the phone that receives the call. ISDN telephone sets typically have an LCD panel showing the number of the calling phone. With a small amount of internal memory augmentation and your own programming, the phone can display the calling person's name, ring differently for calls from certain people, and route incoming calls to other numbers or services based on who is calling.

The next step in the application of this technology is to route the originating number of an incoming call to a local computer that then displays the credit record, buying history, or other caller-related information before the call is answered. This technique can save valuable minutes in order-taking or other heavy-call-handling situations.

ISDN'S NEXT STEP

The bright future of ISDN that few telephone people see is its potential as a pipe

that links millions of personal computers, minis, and mainframes across neighborhoods and cities. The applications that will use these communications links include executive information systems, electronic mail, database access, printer sharing, and a growing list of networked workgroup

**ISDN has much to offer
the average telephone
user besides high-
quality voice calls.**

productivity applications on modern local area networks. People using PCs and other computers need to communicate easily and at high speed beyond the typical 1,000-foot boundaries of local area networks.

The designers of ISDN developed a standard dividing the available bandwidth into three data channels. Two of the channels move data at 64 kbps. The third channel operates at 16 kbps and provides a path

for telephones to send requests to the ISDN switch while moving data from applications at full speed on the data channels.

In ISDN parlance, the 64-kbps data channels are called "B-channels" and the slower 16-kbps signaling channel is called a "D-channel." The typical kind of desktop ISDN service is called 2B+D, or "basic rate" service.

A computer looks at the ISDN line as a wide-open pipe for the transfer of data at nearly 150 kbps in two directions simultaneously. People used to reading about 10-megabit-per-second Ethernet and 16-Mbps token-ring might assume that ISDN is slow in comparison, but LAN schemes like Ethernet and token-ring use sophisticated media-access protocols to control the access of each node to the cable.

LAN nodes must wait, retry, repeat, and do many overhead tasks to share the cable. These actions cut the throughput over the LAN of even the fastest computer to hundreds of kilobits per second instead of megabits. Suddenly, the ISDN pipe doesn't look so thin. You can move a lot of data quickly over a high-quality ISDN circuit because other nodes don't share or contend for its service.

THE BRIGHT LIGHTS

There are companies who understand the potential of ISDN as a communications

ISDN GLOSSARY OF TERMS

Applications processor A special-purpose computer that enables a telephone system to furnish special services such as voice mail, messaging services, and electronic mail.

Automatic Number Identification (ANI) A feature that passes a caller's ten-digit telephone number over the network to the customer's premises so that the caller can be identified.

Basic Rate Interface (BRI) The ISDN standard governing how a customer's desktop terminals and telephones can connect to the ISDN switch. It specifies two B channels that allow 64-kilobit-per-second simultaneous voice and data service, and one D channel that carries call information and customer data at 16 kbps per second.

B channel A "bearer" channel carries either voice or data at 64 kilobits per second in either direction and is circuit-switched.

CCS 7 A network signaling standard for ISDN that incorporates information from databases in order to offer advanced network services.

Central Office (CO) The telephone-switching location nearest to the customer's premises. It serves the businesses and residences connected to its loop lines.

Customer Premises Equipment (CPE) A general term for the telephones, computers, private branch exchanges, and other hardware located on the end user's side of the network boundary established by Computer Inquiry II.

D channel The "data" channel of an ISDN interface, used to carry control signals and customer call data in a packet-switched mode. In the BRI, the D channel operates at 16 kilobits per second; in the PRI, the D channel is used at

(CONTINUES)

platform for computer-based applications. We found six companies with PC-adapters for ISDN available for shipping to systems integrators and technically sophisticated customers, in addition to a seventh product from Hayes expected to reach the market in early 1990. The packages we saw ranged from little more than a bare board begging for third-party application software to a tightly integrated, sophisticated package with software making full use of the multitasking features of OS/2 and the Presentation Manager interface.

In their current incarnations, these ISDN adapters are less than economical for linking individual PCs. Prices of over \$1,500 per machine seem to be the norm. In addition, if you get ISDN service from an RBOC instead of from your own PBX, you must pay tariffed service charges. Various regulatory jurisdictions use different rate packages based on connection time, packet counts, and completed-call charges.

The pricing of ISDN adapters is more typical of products like SNA and X.25 gateways than PC-to-PC LAN interface cards. It seems likely that based on price alone many people will initially use ISDN connections to link traditional LANs rather than replace them.

Today, the ISDN adapters from different manufacturers cannot communicate with each other. The adapters and application programs use the empty ISDN data channel in unique and proprietary ways. An international CCITT standard called V.120 describes data formats in the fast B channels, but few companies have spent money to write software for this standard.

DILEMMAS OF THE EARLY DAYS

You can get around the signaling problem by buying all your adapters from one company, but the problem of having to use unique application software is more vexing. All of the companies we talked to voice support for a universal application software interface, but only Vadis and Hayes Microcomputer Products have tackled the problem. NCR and ICL took a smart, but potentially limiting, sidestep by hosting their ISDN adapters under OS/2.

On local area network adapters, an application interface called NetBIOS gained acceptance without the benefit of being blessed by any standards organization and with only the grudging support of IBM. Today, terminal emulators, electronic mail programs, group schedulers, and many other productivity and communica-

CONNECTIVITY

ISDN

**Since ISDN and OS/2
are both inherently
multitasking, they
prove to be an
excellent match.**

tions programs use NetBIOS as a standard interface to any of dozens of LAN adapter cards. Programmers don't worry about the vagaries of specific network adapters; they count on a NetBIOS program to carry the data between their application and the adapter.

Vadis includes a full implementation of NetBIOS (except, of course, for the network broadcast feature) in its software

package. Hayes Microcomputer Products developed an ISDN BIOS product, closely related to NetBIOS, for its ISDN adapter products.

NCR and ICL created a standard OS/2 device driver for their ISDN adapter. OS/2 programmers can use standard read/write calls to pass data over the NCR ISDN adapter. This is an intelligent move because since ISDN and OS/2 are both inherently multitasking, they make an excellent match. But the success of these products is directly tied to the growth of the overall OS/2 application market.

Some companies have unique APIs that they expect product developers to follow. Teleos has a "NetBIOS-like" interface using the 5Ch NetBIOS interrupt, but with different data formats. AT&T uses the 14h communications interrupt for its API, but the interface does not follow the standard DOS INT14 communications programming structures. The lack of a standard or popular programming interface will limit the number of third-party companies porting their applications to these adapters.

ISDN GLOSSARY OF TERMS

(CONTINUED)

64 kilobits per second.

Digital switch A switch that links two connections and carries digital signals instead of analog voice signals.

DTMF The frequency of the tones generated by a telephone.

Integrated Services Digital Network (ISDN) As officially defined by CCITT, ISDN is "a limited set of standard interfaces to a digital communications network." The result is a network that offers end users with voice, data, and certain image services on end-to-end digital circuits.

Packet switching A transmission technique that maximizes the use of digital transmission facilities by transmitting packets of digital data from many customers simultaneously on a single communications channel.

Primary Rate Interface (PRI) In ISDN, PRI refers to the specification for the interface at each end of high-volume trunks linking PBX and central office facilities or connecting network switches to each other. The "primary rate" consists of 23 B or "bearer" channels operated at 64 kbps and a D or "data" channel also functioning at 64

kbps. The combined signal-carrying capacity is 1.544 megabits per second (Mbps)—equivalent to a digital signal hierarchy level of DS-1.

T Interface A standard BRI interface using four copper wires.

T-1 transmission system The most popular digital copper transmission system and the rate at which it operates (about 1.5 Mbps). This operating rate is equal to the DS-1 rate of the digital transmission hierarchy.

Terminal Adapter (TA) An ISDN phone or a PC card that emulates one. Devices on the end of a BRI line are known as terminals because they are capable of "intelligence."

U Interface A standard BRI interface using two copper wires.

Virtual circuit A temporary connection path, set up between two points by software and packet switching, that appears to the user to be as available as a dedicated circuit. This "phantom" circuit can be maintained indefinitely or can be ended at will.

(Portions of this glossary were prepared by AT&T Bell Laboratories for AT&T Network Systems and reprinted with its permission.) ■

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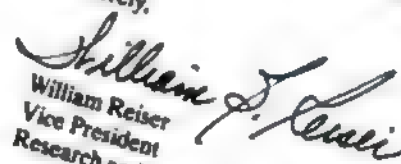
Dear Ms. Merkel:

Thank you for your interest in the New World Products Company. I don't normally respond to unsolicited queries, especially in light of the recent decline in venture capital (see chart). But I noticed from your sharp text and graphics that you printed your letter with the HP DeskJet PLUS printer. It made your excellent product suggestions seem even better.

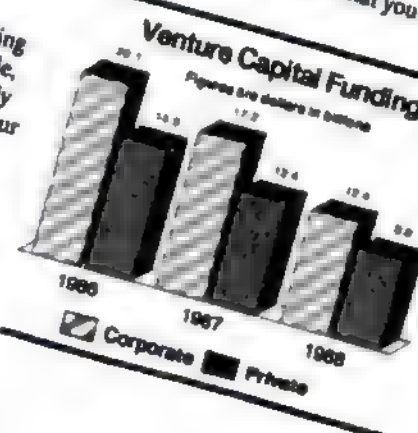
In fact, we're interested in developing many of those products. For example, the new uses for our enormous supply of polymer and the repositioning of our line of insecticides. Your thinking is very impressive as is the presentation of your ideas.

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**HEWLETT
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TESTING BY FIRE

PC Magazine invited these companies to an ISDN facility graciously provided by AT&T Network Systems, where the adapter cards were tested and demonstrated. But we found that these six products were so different that there was no common point to run meaningful benchmark tests. We gained hands-on experience with each package in an ISDN environment, but because of the different applications and ISDN services these products use, they can't be tested head-to-head.

It made no sense, for example, to compare the 19.2-kbps D-channel file transfer used by Progressive Computing with the 64-kbps B-channel transfers used by NCR or the fast transfers offered by Teleos using the DCA *Crosstalk Mk.4* fast file transfer protocols. Instead our reviews focus on the features and, in large part, on the futures of these products.

If you manage a group of PCs in one of the increasing number of ISDN geographic areas, you'll hear about ISDN. This exciting communications alternative can serve you to link PCs, mainframes, and existing LANs across miles and, eventually, thousands of miles of fast digital service. At the moment ISDN is economical primarily for linking LANs, but in the near future it can replace and displace today's traditional local area network in many installations. It may not be long before the LAN of the 1980s is forced to step down from the connectivity throne.

AT&T

AT&T PC/ISDN Platform

All reviews by M. Keith Thompson

AT&T teamed up with DCA, a big name in the 3270 world, to pair up the DCA IRMA 3270 terminal emulation package with the AT&T PC/ISDN Platform. Priced at \$1,790, the combined product represents a strong solution for many corporate communications environments. Users comfortable with IRMA 3270 will feel right at home with this dual creation; AT&T left the 3270 user interface intact.

AT&T's ISDN card uses a Motorola 68000 CPU with 512K RAM, upgradable to 1MB with 256K ZIPs. Although this design adds to the cost, it does offer the greatest range of functions because as ISDN specifications change, the PC/ISDN Plat-

CONNECTIVITY

ISDN



FACT FILE

AT&T PC/ISDN Platform

AT&T, 55 Corporate Dr., Bldgwater, NJ 08807; (201) 658-2604

List Price: \$1,790

Requires: 640K RAM, DOS 3.x or later. Access to AT&T 5ESS CO switch with 5E4.X or 5E5 software; BRI S or T interface or U interface with an NT1 (two-to-four-wire converter).

In Short: A complete platform for developing ISDN voice and data applications, and a powerful 3270 terminal emulation product as well. However, the package's lack of support for Northern Telecom and Siemens CO switches could limit its appeal.

CIRCLE 548 ON READER SERVICE CARD

form can easily evolve to accommodate them. The programs that talk to the 5ESS CO switches are called in the CONFIG.SYS and load to the card on power-up. Updates necessitated by changes in

ISDN specifications can be ported to customers by sending them new disks.

AT&T's designers use an ISDN telephone set instead of a standard phone in conjunction with the PC/ISDN Platform, adding to the cost of the total package. However, unlike cards designed by other companies, the PC/ISDN card doesn't require an external power supply for the adapter card to run the phone when the computer is off.

The high-level API lets programmers create applications using ISDN without having to learn the hardware-level technology. Since the API resembles the BIOS INT14 functions, programmers familiar with writing communications programs will be up and running after a little study to learn the differences between DOS INT14 calls and AT&T's API. The API supports synchronous as well as asynchronous data transmission and voice calls.

For greater use, the PC/ISDN Platform

SO MUCH POTENTIAL, SO LITTLE INSIGHT

by Frank J. Derfler, Jr.

ISDN has one big problem: the development of ISDN products is largely in the hands of voice telephone managers who haven't conceptualized or funded applications more impressive than customized telephone answering. They either don't understand, or haven't acted on their understanding of, the potential of ISDN for desktop-to-desktop and PC-to-PC communications. ISDN is mismarketed, misregulated, and misapplied.

ISDN has tremendous potential for service to its users and profit to its providers. The technology is available and widely understood; the barriers to ISDN's success are managerial and bureaucratic rather than technical. The obstacles include the inability of ISDN program managers to grasp the importance of computer-based applications—as well as low development funding, poor pricing and lack of leadership in the regulatory area.

Knowing the identity of the caller in advance is a novelty with more sizzle than substance, but this feature is the keystone of most ISDN marketing and press releases. But even if the primary attraction of ISDN is the incoming call identification, the companies pushing ISDN have done a poor job of provid-

ing ways to use such information.

For example, despite the desirability of using a multitasking, multiuser minicomputer database to retrieve the records of incoming callers, AT&T has no ISDN adapter cards for its line of 3B/2 Unix-based minicomputers. Even at the company that is a leading power behind the use of ISDN, the vision of doing anything beyond fancy telephone answering is dim—or if the vision is there, the commitment isn't.

Companies such as Northern Telecom and AT&T that make ISDN switches see RS-232C port attachments on digital phones as the primary method of linking desktop computer equipment to ISDN. This is similar to the largely unsuccessful digital Centrex strategy that many local telephone companies offer to link PCs, terminals, and host computers. Serial port attachment at 9.6 kilobits per second—or even 19.2 kbps—doesn't meet the needs of PC application developers and users.

The designers of ISDN saw the need for circuits to carry high-speed computer data and created channels to carry it, but the managers, marketers, and regulators lost sight of the goal.

Even adapter price is an issue. There isn't a high-level of price sensitivity in LAN and connectivity products, but

allows multiple boards to reside in the same computer. This feature allows you to create a multitasking server with applications controlled through ISDN connections. For example, you could create an application allowing people on telephones throughout the world to connect to a PC and, using DTMF buttons, access data and initiate computing tasks.

In addition to working with CO switches, the PC/ISDN Platform works on the Definity line of AT&T PBX products. Companies outside the ISDN service area can implement their own ISDN internally and connect to the public network when it is available. Your investment in AT&T PC/ISDN cards will not be lost as the network expands.

AT&T Bell Laboratories is one of the most technically sophisticated facilities in the world and has been a major force in the development of ISDN. The company's understanding of the current technology and

its future direction enhances the value of a PC/ISDN Platform purchase.

The AT&T PC/ISDN Platform supplies application developers with the environment and tools for building complete ISDN voice and data applications. Even without support for non-AT&T CO switches, AT&T's size and experience in assisting developers makes its PC/ISDN Platform a good choice.

ICL
ICL I³

One dilemma facing all vendors of ISDN PC adapters is how to integrate a voice telephone into the ISDN system. ISDN phones have displays and programmable

buttons for the many features ISDN offers, but the price of combining the ISDN phone and PC adapter is high. ICL has found a smart compromise: to include an ISDN-like speaker phone in the \$1,695 I³ package. The phone has programmable buttons like an ISDN set, but it will work only with the I³ adapter.

In addition to its intelligent phone, ICL Network Systems' entry combines an adapter card, telephone management software, and an API software module into a package called the ISDN Information Integrator—I³, for short. The designers at ICL apparently believe in the future of OS/2, because their software runs only under Microsoft's multitasking operating system.

If you're worried about support, ICL has a distinct advantage over its ISDN competitors. Its parent company, Standard Telephone and Cable, produces all the cable, analog switching equipment, and R&D for many national and commercial

they must keep in line with the rest of the market. The most expensive microprocessor-augmented PC LAN adapters sell for under \$800. The market is comfortable with less-sophisticated adapters selling in the \$400 bracket. But at an average price of \$1,500, today's ISDN adapters for PCs go beyond what is reasonable to spend for every desktop machine.

If the present price structure for ISDN PC adapters and service continues, the potentially useful and lucrative idea of ISDN for moving computer data will flop. Innovative managers will establish ISDN network gateways to link LANs across town with a few data channels, but one adapter per LAN is far from the critical mass the companies involved with ISDN need to get returns on their investments. Reasonably priced ISDN PC adapters, for perhaps under \$800, will go a long way toward making desktop ISDN links a reality.

The prices of these products relates directly to their designs. The microprocessor-equipped adapters we saw are powerful and impressive. This design strategy takes the significant load of handling serial communications off the host CPU—for a price. But a line of less-powerful and less-expensive adapters that take advantage of the un-

derutilized host CPUs available in many machines, particularly under multitasking systems like *DESQview* and OS/2, would be welcome.

A nontechnical barrier to the smart implementation of ISDN as a link for computers across cities comes from the regulators of telephone services in each jurisdiction. If you get ISDN services

**Smart development
and grooming of ISDN
PC interfaces can put
this technology on the
side of success.**

from your own PBX, no one regulates the price or the way you configure the services. But if you buy ISDN services from a local telephone carrier, state and perhaps local public-utility commissions regulate the rates you pay and, through the rate structure, the services you can order.

In Illinois, for example, the tariffs

make the use of X.25 packet-switched service operating at 9.6 kbps over the slow D channel—for little or no cost. At the same time, charges are either high or undefined for high-speed packet switching over the B channel. This regulatory structure fosters the use of the slow service for computer-to-computer links while stunting the potentially useful growth of high-speed services. Users and managers of the first trial ISDN computer links get the impression that ISDN is slow because their experience is with the cheap, but not the fast, service.

Unfortunately, few people have emerged to show regulators and service providers that the high-speed data service applications should be nurtured and supported through smart pricing. Dennis Hayes, founder of Hayes Microcomputer Products, has done more ISDN missionary work than anyone else in this area, but there are many souls left unsaved.

Smart development and grooming of ISDN PC interfaces can push this teetering technology back on the side of success. But the news today isn't cheery. Companies must create changes in attitudes and development priorities before ISDN PC products can help push ISDN to success. ■

telephone companies around the world.

ICL worked with Siemens to jointly develop the ISDN chip set most vendors use on their cards. The I³ adapter card comprises 1MB RAM and an 80188 running at 8 MHz. This coprocessor-based design stores data, runs programs out of its on-board memory, and does not burden the PC's CPU or RAM with communications tasks. Even better, the I³ emulates a COM port, allowing you to use your favorite OS/2-based communications program.

I³'s telephone management interface and phone book are well designed. Nearly every feature can be activated three different ways. This allows ISDN users who are comfortable with command line interfaces to use the keyboard, GUI lovers to use the mouse, and button pushers to use the phone.

Like several of the products in this review, the I³ software presents an on-screen window that emulates the LCD of an ISDN phone, an elaborate phone book, and ICLID lookup capability. But the software has many other useful features. A list called "Recent Calls" provides a mechanism for returning calls. As calls come in, this list keeps track of the last ten calls you didn't answer.

The I³ software translates words to numbers as they are dialed. Another extra is I³'s ability to dial phone numbers from



FACT FILE

ICL P

ICL, 777 Long Ridge Rd., Stamford, CT 06902; (800) 446-ISDN, (203) 968-7222.

List Price: \$1,695.

Requires: 4MB RAM, OS/2, AT or compatible. Access to AT&T 5ESS CO switch with 5E4.X or 5E5 software, or to Northern Telecom DMS-100 CO switch with BCS-29 software, or to Siemens EWSD CO switch with 4.0 software; BRI S or T interface or U interface with an NT1 (two-to-four-wire converter).

In Short: A good ISDN PC terminal adapter with some intuitive software, although developers will sorely miss an API for data calls. If you can afford the hardware necessary to run OS/2 efficiently, this product will not disappoint you.

CIRCLE 549 ON READER SERVICE CARD

any application on the screen—just move the cursor to the number, and the software reads it.

I³ transfers data on either 64K or 56K B channels and X.25 packet on the D channel, giving users a variety of ways to communicate with the outside world. ICL doesn't include terminal emulation software with I³. Since it emulates a COM port, you can use any OS/2 communications program with terminal emulation.

One optional application offered by ICL is *DeskTop Conferencing (DTC)*.

DTC is a program like *PC Anywhere*, *Remote 2*, or *Carbon Copy*, but with the addition of an electronic white board. When *DTC* links two PCs, both screens update, but only one person can enter data at a time. *DTC* lets you use a mouse or other drawing device to make notes, circles, and crossouts, and all conferenced parties see them as they are added. Additionally, each participant can make notes to which *DTC* assigns a different color for clarity. These images can be saved to disk and recalled flip-chart-like with the PgUp and PgDn keys. A \$295 version of *DTC* links two users. A \$495 version increases the license to eight users; however, concurrent links between more than one station are not yet a part of typical ISDN service.

I³'s library of ten C functions lets programmers act as coders and not hardware techies. Users simply make programming references to these functions, and the card does the rest. However, the API is currently limited to managing voice calls, so the ability of simple programs to manage data calls is limited.

The multitasking capabilities of OS/2 and ISDN complement each other. ICL has hardware and software that easily links the two architectures. Solid hardware design and software with tangible features and benefits make I³ one of the better offerings around.

HAYES: The Company with the Right Idea

by Frank J. Derfler, Jr.

One of the potential leaders in the ISDN adapter market, Hayes Microcomputer Products, did not release a product in time for our review. However, Hayes is active in ISDN development work; it first demonstrated a prototype adapter called the Hayes ISDN PC Card in October 1987.

Technically, the Hayes prototype is designed along the lines of the other adapters tested for this review. It includes on-board processing and the ability to use standard analog phones on ISDN service through the adapter board. Hayes is marketing slower external ISDN interfaces and the internal PC adapter with higher throughput should be available in early 1990.

The Hayes ISDN development program is worth mentioning for other reasons. The Hayes modem command set—those commands you send to mo-

dem prefaced by "AT"—is the accepted standard of the modem industry. Hayes expanded the AT command set with more functions unique to ISDN. New AT commands give application programs the ability to control ISDN services ranging from dialing a voice phone call to managing multiple data connections.

The AT command set enhanced for ISDN is a powerful programming language that any application or communications program can use by sending the appropriate ASCII characters to the adapter. People and programs can use the extended AT command set to create and manage ISDN virtual-circuit connections without complex programming chores.

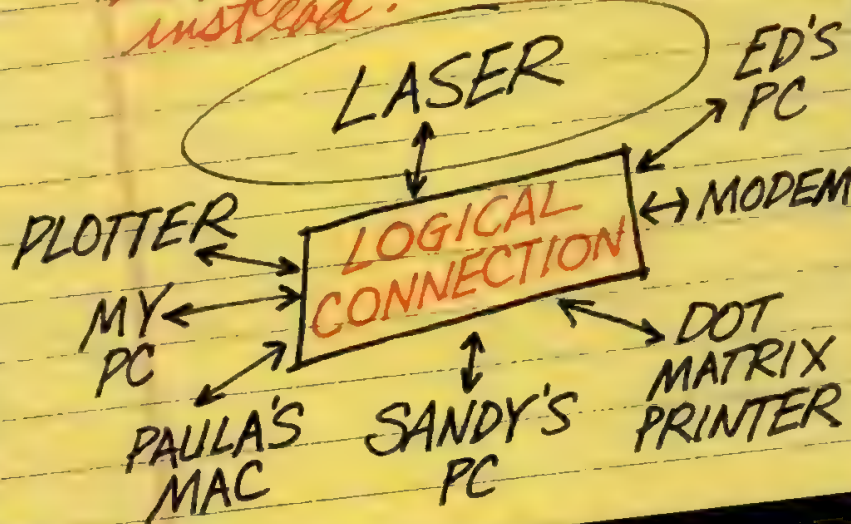
Equally noteworthy is the development of the Hayes ISDN BIOS. The Hayes ISDN BIOS extends NetBIOS to support ISDN network features. This

interface gives application programs the ability to exchange packets of data with the ISDN adapter at high speed. Since this interface is an expansion of NetBIOS, off-the-shelf programs like LAN Gateways and electronic mail packages that already use NetBIOS are compatible and can use ISDN links. However, the expansion of NetBIOS for ISDN lets new or revised programs use unique ISDN connection services.

The introduction of the Hayes AT command set enhanced for ISDN and the ISDN BIOS are two critical factors that open ISDN for standard PC applications. If more companies in addition to Hayes Microcomputer Products make ISDN easy for other developers to use, the services will grow and prosper. Without these interfaces and others, ISDN faces a bleak future as the basis for fancy telephone answering machines. ■

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those costly peripherals.

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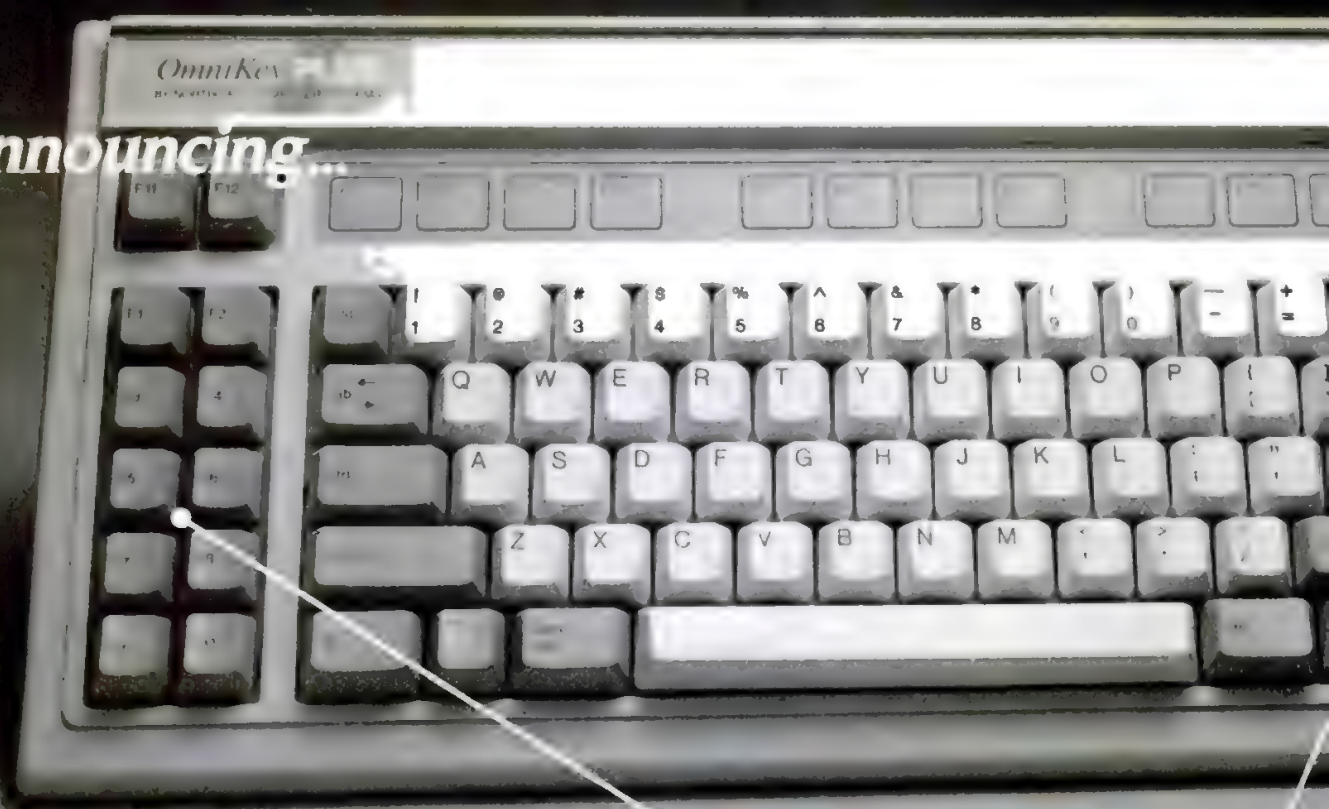
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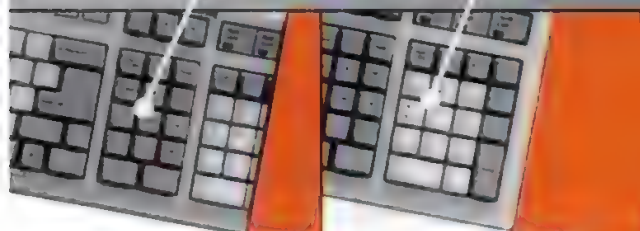
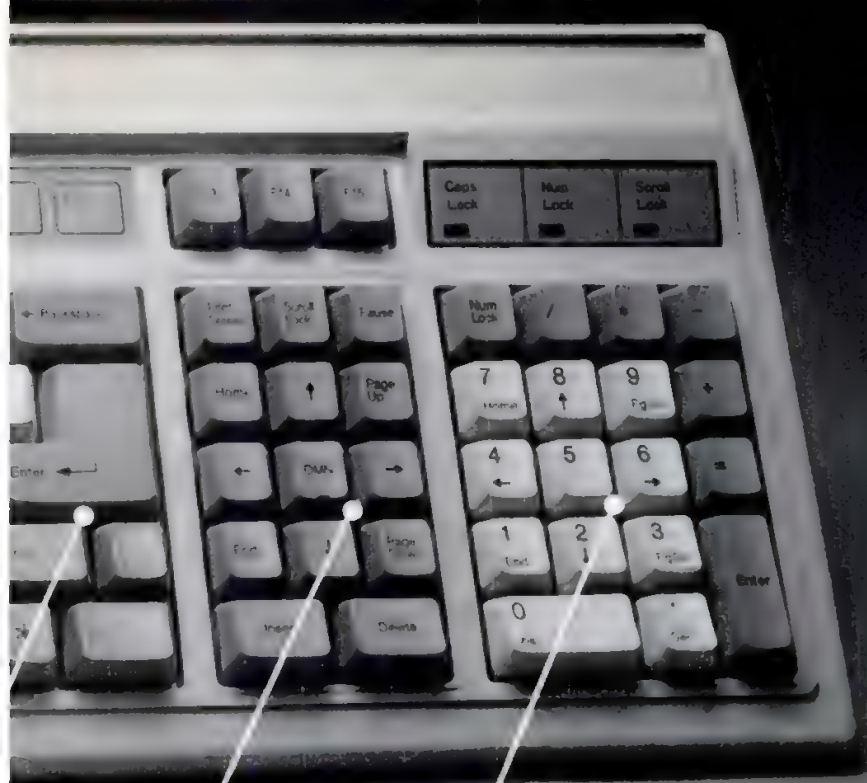
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ISDN TERMINAL ADAPTERS: SUMMARY OF FEATURES

Products listed in ascending price order

General AT&T, Northern Telecom, and Siemens all market ISDN switches to telephone companies. You must select an adapter compatible with the switch providing the service.

Data transfer on B channel The software delivered with the product determines the type and speed of data transfer on the B channel. PC applications typically demand high throughput; throughput rate is given in kilobits per second (kbps). The ability to use the V.120 standard is highly desirable.

Hardware If an adapter emulates a communications port, standard application programs can use it over ISDN. If it detects incoming DTMF, calling phones can control specially written applications.

Software Software with the ability to pass the incoming call identification (ICLID) to a database can be quickly integrated into applications. Adapters with a NetBIOS interface can use many off-the-shelf applications.

Phone features If an adapter uses a normal analog phone for ISDN voice service, costs are lower, but ISDN functions must be performed on the PC's screen. If the computer is off, ISDN functionality is temporarily lost. The "passive bus" ISDN connection allows full ISDN phone service even with the PC off, but the instrument costs more.

Progressive
Computing
ISDN
tel/adapterNCR
ISDN/PCTA

	AT&T PC/ISDN Platform	Vadis ISDN PC System	Progressive Computing ISDN tel/adapter	ICL P	NCR ISDN/PCTA	Teleos B100PC
GENERAL						
List price	\$1,395	\$1,465	\$1,495	\$1,695	\$1,695	\$1,695
Compatible with AT&T 5ESS	■	■	■	■	■	■
Compatible with NTI DMS-100	□	■	□	■	□	■
Compatible with Siemens EWSD	□	□	□	■	□	■
DATA TRANSFER ON B CHANNEL						
Circuit-switched	■	■	□	■	■	■
X.25-packet-switched	□	■	■	■	■	□
V.120-packet-switched	□	□	□	■	■	■
Maximum transfer rate (kbps)	64	54	19.2	64	64	64
DATA TRANSFER ON D CHANNEL						
X.25-packet-switched	■	■	■	■	■	■
HARDWARE						
Emulates COM ports	None	COM1, COM2	COM1, COM2	COM1, COM2 (with V.120)	COM1, COM2, COM3, COM4	None
Maximum COM port speed (kbps)	N/A	19.2	19.2	64	38.4	N/A
Uses Hayes AT command set	□	■	■	□	■	□
Detects remote DTMF	■	□	□	□	■	□
Integrated voice mail	□	□	□	□	■	□
On-board processor	68000	80C188	80186	80188	80188	68HC000
Standard processor RAM	512K	512K	512K	1MB	256K	512K
Maximum processor RAM	1MB	1MB	512K	1MB	256K	512K
RAM shared with system	16K	8K	64K	NONE	2K	32K
SOFTWARE						
TSR (RAM required)	□	■ (242K)	■ (85K)	□	□	■ (50K)
With EMS 3.2	N/A	■ (184K)	□	N/A	N/A	□
With EMS 4.0	N/A	■ (127K)	□	N/A	N/A	□
Phone directory	□	■	■	■	■	■
Terminal emulation included	■	■	■	Optional	□	Optional
Uses ICLID for database lookup	■	■	■	■	■	□
Has API for developers	■	■	■	■	■	■
Has NetBIOS interface	□	■	□	□	□	□
Operating system	DOS	DOS	DOS	OS/2	OS/2, DOS	DOS
PHONE FEATURES						
Uses normal phone	□	■	■	□ (package includes ISDN- like phone)	■	■
Phone rings generated on	Phone (card speaker with hand/headset)	Card speaker	Card speaker	Phone	PC speaker (with optional power supply)	Card speaker
Uses ISDN phone	■	■	□	□	■	□
On passive bus	□	■	N/A	N/A	■	N/A
Terminal adapter card between phone and CO	■	□	N/A	N/A	□	N/A

□—Editor's Choice ■—Yes □—No

N/A—Not applicable; product does not have this feature.

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NCR CORP.

NCR ISDN/PCTA

The potential size of the ISDN market is evidenced by NCR's devotion to using the full power of this new technology. NCR furnishes a PC platform for complete communications, ranging from voice messaging to data transfers under the OS/2 operating system. NCR not only sells its ISDN/PCTA as a \$1,695 standalone product, but also offers a complete ISDN workstation, including the computer, operating system, and ISDN/PCTA as well.

The NCR ISDN/PCTA's dual processor and 16-bit bus design make it the most powerful adapter we tested. The card derives its power from an 8-MHz 80188 and 256K RAM handling the communications tasks, and a TI 320C10 digital signal processor (DSP) for extra processing power.

The ISDN/PCTA lets you use your existing communications software in DOS and OS/2 by emulating serial ports. It supports dial-up connections using standard Hayes command strings. And while it doesn't have a full emulation of the Hayes AT Command set, the card does include the functions necessary for talking over a BRI line at speeds up to 38.4 kilobits per second. Keep in mind that while you cannot transfer data over a normal phone line

CONNECTIVITY

ISDN

can use a normal analog modem for communicating with people outside your ISDN island.

Installation of the ISDN/PCTA is quick and easy. You simply set IRQ and I/O address space jumpers so as not to conflict with other devices installed in your computer, then plug in the card. The configuration and setup program, TASETUP,

The NCR Voice/Data Manager's OS/2 design supports multiple concurrent tasks.

copies the files from the floppy to the hard disk and helps you match the program files with the hardware settings.

The ISDN/PCTA and its accompanying Voice/Data Manager (VDM) software transforms a mild-mannered telephone into a phone allowing access to ISDN features like multiple call appearances, hold, conference, transfer, and concurrent voice and data communications.

VDM's configuration option customizes the features of the software and hardware packages. VDM itself is a multifunction OS/2 Presentation Manager application with sophisticated telephone management capabilities. VDM's OS/2 design supports multiple concurrent tasks and an easy-to-use icon-based interface.

Although using a standard telephone with ISDN can be somewhat difficult, NCR's VDM software puts a friendly implementation of an ISDN set on your computer screen. The call messages list the names of callers and are color-coded to show the status of each call. A small window in VDM simulates the LCD display of an ISDN set.

As with most of the other programs tested, VDM includes an electronic phone book. In addition to the standard name and address fields, VDM allots ample room for other information, with two 50-character note fields and two other special fields. You can also enter phone numbers as words and let VDM translate them at dialing time.

A nice bonus is the VIP call transfer op-

tion. When you go to another phone and want certain people to get in touch with you, VDM will selectively transfer calls to you if you have those numbers marked in your phone book.

NCR includes a voice mail system with the ISDN/PCTA. Voice messaging is an integral part of day-to-day communications in many organizations, but the customized ISDN/PCTA system allows more flexibility than large corporate services. Unlike most company-wide systems, you can create personalized greetings for many individuals or classes of callers; since the computer knows who is calling, each caller gets an appropriate greeting.

NCR's programming interface is the most sophisticated we've seen. It furnishes developers with all the tools necessary to create nearly any type of voice and data application. With its standard OS/2 device driver, OS/2 programmers can start coding right away. NCR supplies the API for both DOS and Unix platforms as well.

The addition of digital signal processing capabilities sets the ISDN/PCTA apart from the crowd. NCR uses the on-board DSP for its voice messaging feature, but developers can use it for other things. For example, programmers can use it to develop Fax, text-to-speech, and voice-recognition applications.

NCR has a first-rate product. The quality of the ISDN/PCTA, VDM, API, and documentation are second to none. If you currently have two voice lines and a data line and use them all, the ISDN/PCTA can make your life simpler. If you are considering the move to OS/2, ISDN/PCTA's usefulness could tip the scales in OS/2's favor. Developers and end users alike cannot go wrong with this product.



FACT FILE

EDITOR'S CHOICE

NCR ISDN/PCTA

NCR Corp., Workstation Products Division, 1601 S. Main St., PCD-5, Dayton, OH 45479; (800) 544-3333.

List Price: \$1,695.

Requires: 3MB RAM, OS/2, AT or compatible. Access to AT&T 5ESS CO switch with 5E4.X or 5E5 software; BRI S or T interface or U interface with an NT1 (two-to-four-wire converter).

In Short: Because it runs under OS/2, the ISDN PCTA ensures a simple migration to ISDN. An excellent hardware platform and sophisticated telephone management makes it a good choice for developers and end-users.

CIRCLE 602 ON READER SERVICE CARD

to a modem—the connection must be ISDN end-to-end—you can use standard modem communications software.

To help make the cost of migration to ISDN bearable, NCR chose to use a standard telephone instead of an expensive ISDN set. Despite the initial savings, this design's drawback is that it forces you to use your computer to activate ISDN functions assigned to feature buttons. Still, you

PROGRESSIVE COMPUTING INC.

Progressive Computing ISDN tel/adaptor

Progressive Computing, founded in 1985, is one of the oldest of the small companies in the ISDN field. Its location in Oak Brook, Illinois, one of the first cities offering tariffed ISDN service, puts it on the forefront of commercial ISDN offerings. Progressive Computing makes several different ISDN products for companies capitalizing on this new technology. Its

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CONNECTIVITY

ISDN

\$1,495 ISDN tel/adaptor offers the widest range of software functions of all the units tested here.

Powered by an 8-MHz 80186, the tel/adaptor has 512K RAM for faster communications. The card also includes a sharable 64K chunk of memory that yields speedier data transfers from the tel/adaptor to the PC. The package includes a configuration program that makes it easy to set the DIP switches for the proper I/O address, interrupt, and shared memory address.

The ISDN tel/adaptor enables you to make multiple simultaneous voice and data calls, identify incoming callers before answering, and invoke other processes based on the callers ICLID. The software that controls these features is a 70K background TSR, called *TA*, that handles communications while you work. *TA* is very flexible and can be customized to suit your fancy. If 70K of memory is tough to give up, *TA* is compatible with Quarterdesk's *DESQview* and can be run in its own 70K window.

What appears at first to be an advantage, however—the ability to use a standard phone—turns out to be somewhat of a limitation. The tel/adaptor accommodates the standard phone by duplicating all of the

**API programmers
yearning to write
applications for ISDN
will heartily approve of
the tel/adaptor. The API
is designed with
multitasking in mind,
enabling multiple
applications to have
simultaneous access.**

and reload the TSR.

Auto-dialers are not new software tools, but Progressive's dialer does a bit more than most. You can search the directory by area code, phone number, or name. After the call has been made, a call-logging function takes over and records the date, time, and length of the call. Another asset is that the software automatically adds incoming phone numbers to your phone book.

Progressive offers more flexibility in using the ICLID than do most other products. The ISDN tel/adaptor can look up a received ICLID in its own directory, make a data connection to a minicomputer, or use its keyboard macro facility to pass the ICLID along to a program on your desktop computer.

The ISDN tel/adaptor includes VT-100, VT-52, and ANSI terminal emulators and supports four concurrent sessions. If you need other terminal emulators or would like to use your favorite communications program, the tel/adaptor emulates a Hayes modem on either COM1 or COM2, with a maximum speed of 19.2 kilobits per second. The only disappointment was its lack of high-speed data transfer. PC-to-PC file transfers over the B channel are limited to the same 19.2 kbps as the asynchronous operation.

API programmers yearning to write applications for ISDN will heartily approve of this card. In addition to the card's solid

hardware foundation, Progressive offers a C library of routines that communicate with the tel/adaptor. These routines do all the dirty work needed to communicate on an ISDN BRI line. In addition, the API is designed with multitasking in mind, enabling multiple applications to have simultaneous access.

Although it lacks 128-kbps file transfers, the tel/adaptor furnishes one of the most highly integrated software environments of all the products we tested. Sound hardware design and an excellent API for creating custom programs make the Progressive Computing system a reasonable choice for those wishing to migrate to ISDN.

TELEOS COMMUNICATIONS INC.

Teleos B100PC

Founded in 1983 by a former Bell Labs engineer, Teleos Communications is one of the most versatile companies in the young ISDN industry. It offers a wide variety of ISDN products, including system testers and network emulators. The \$1,695 Teleos B100PC ISDN adapter rounds out its product line.

Teleos has a simple approach to bringing ISDN into your work environment. For developers aspiring to create the next killer application, Teleos offers an API similar to NetBIOS, which makes it easy to write code that talks to the B100PC. People who want to use the product today can take advantage of a driver for DCA's *Crosstalk Mk.4* and effect high-speed data transfers.

FACT FILE

EDITOR'S CHOICE

Progressive Computing ISDN tel/adaptor

Progressive Computing Inc., 814 Commerce Dr., Oak Brook, IL 60521-1919; (708) 574-3399.

List Price: \$1,495.

Requires: 85K RAM, DOS 3.1 or later. Access to AT&T 5ESS CO switch with 5E4.X or 5E5 software; BRI S or T interface or U interface with an NT1 (two-to-four-wire converter).

In Short: Except for the lack of high-speed circuit-switched data transfers, the ISDN tel/adaptor supplies a complete communications management environment. Ease of use and strong interfacing ability make this package a good choice.

CIRCLE 803 ON READER SERVICE CARD

ISDN phone features as a graphic on your computer screen and by powering its card with an external power supply. A small area on the monitor screen duplicates the LCD display on an ISDN set. Any display data destined for your phone shows up here, including the ICLID and a name from an application processor. All well and good while your computer is on. But if the computer is off, the communications-controlling software is absent, and your ISDN telephone service is no longer operational until you turn the machine back on

FACT FILE

Teleos B100PC

Teleos Communications Inc., 2 Meridian Rd., Eatontown, NJ 07724; (201) 389-5700

List Price: \$1,695

Requires: 50K RAM, DOS 2.0 or later. Access to AT&T 5ESS CO switch with 5E4.X or 5E5 software, or to Northern Telecom DMS-100 CO switch with BCS-28 software, or to Siemens EWSD CO switch with 4.0 software; BRI S or T interface or U interface with an NT1 (two-to-four-wire converter).

In Short: Teleos offers a well-designed adapter and a good choice for developers and end-users alike. The package includes a *Crosstalk Mk.4* driver for fast data communication but lacks a powerful phone management system based on the ICLID.

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If you experience a problem with anything you purchase from CompuAdd, call 800-666-1872 weekdays from 8:00am to 7:00pm, CST. Our technical support staff will be happy to assist you with any hardware or software difficulty. If we cannot resolve a hardware problem over the phone, we will assign you a return material authorization (RMA) number. You ship the equipment to our Austin Service Center freight and insurance prepaid. We will repair or replace the product (at our option) without cost to you and pay for the return freight. You may also carry the product into one of our North American Superstores where our repair staff can assist you on the premises. Call 800-666-1872 for a copy of CompuAdd's complete warranty.

3. No-Charge 90-Day Express Part or Product Exchange for Mail Order Customers

If a problem affects the service or operation of a component purchased as a CompuAdd system (CPU, monitor, or keyboard) in the first 90 days, we will determine the cause and, if needed, ship a replacement part or product within 48 hours (depending on availability of part), via Federal Express® standard air—at our expense.

4. Onsite Service Available

Onsite service is available within 250 Meters/Telex service areas nationwide on all CompuAdd systems. The CompuAdd 220 and 300-series systems come with FREE onsite service during the initial one-year warranty period. Purchasers of other CompuAdd systems may buy a year of onsite service at the time of purchase. Extended two- and three-year warranties are also available on all CompuAdd systems. A completed service agreement must be received prior to onset of any onsite coverage.

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- 0 wait state page-mode memory
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- Built-in dual diskette drive controller
- Built-in parallel port and two serial ports

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 - 101-key enhanced keyboard
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The CompuAdd 316s

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 - Built-in dual diskette drive controller
 - Built-in parallel port and two serial ports
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 - 101-key enhanced keyboard
- Monitor optional.

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40MB (28ms)	64732 — \$1499	64737 — \$1849	64742 — \$1839
80MB (19ms)	64733 — \$1729	64738 — \$2079	64743 — \$2169

CompuAdd 316s Monitor And Hard Drive Options

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40MB (28ms)	64788 — \$2099	64943 — \$2449	64793 — \$2539
80MB (19ms)	64789 — \$2329	64944 — \$2679	64794 — \$2769
110MB (19ms)	64790 — \$2529	64945 — \$2879	64795 — \$2969

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\$2649

64812

PC Magazine, February, 1989

- 80386 processor running at 16MHz
- 0 wait state page-mode memory
- 1MB RAM expandable to 10MB
- Disk caching software
- LIM 4.0 support
- Dual diskette controller with dual hard drive interface
- Built-in parallel port and two serial ports
- Five available expansion slots
- 80387 math coprocessor socket
- 101-key enhanced keyboard
- 5.25" 1.2MB or 3.5" 1.44MB diskette drive

- 40MB hard drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- New Spinnaker® Eight-in-One™ integrated software
- **Free one-year onsite service**

Color monitor optional.

The CompuAdd 320

"The in-house engineered (320 and 325) are a big step in the right direction."

\$3095

64823

PC Magazine, May 30, 1989

- 80386 processor running at 20MHz
- High-speed cache memory controller with 32KB of static RAM cache
- 1MB fully available RAM expandable to 16MB
- Disk caching software
- LIM 4.0 support
- ROM shadowing into faster DRAM
- Dual diskette controller with dual hard drive interface

- Built-in parallel port and two serial ports
- Five available expansion slots
- 80387 math coprocessor socket
- 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- 40MB hard disk drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- 101-key enhanced keyboard
- New Spinnaker Eight-in-One integrated software
- **Free one-year onsite service**

Color monitor optional.

The CompuAdd 325

"Each (386) system comes packed with features—and at prices that won't empty your savings account."

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64836

PC Magazine, May 30, 1989

- 80386 processor running at 25MHz
- High-speed cache memory controller with 32KB of static RAM cache
- 1MB full available RAM expandable to 16MB
- Disk caching software
- LIM 4.0 support
- ROM shadowing into faster DRAM
- Dual diskette controller with dual hard drive interface
- Built-in parallel port and two serial ports
- Five available expansion slots
- 80387 math coprocessor socket
- 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- 40MB hard drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- 101-key enhanced keyboard
- New Spinnaker Eight-in-One integrated software
- **Free one-year onsite service**

Color monitor optional.

CompuAdd 316 Monitor And Hard Drive Options

	MVGA	CVGA
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80MB (19ms)	64813 - \$2879	64818 - \$3129
110MB (19ms)	64814 - \$3079	64819 - \$3329
150MB (18ms)	64815 - \$3529	64820 - \$3779

CompuAdd 320 Monitor And Hard Drive Options

	MVGA	CVGA
40MB (28ms)	64823 - \$3095	64829 - \$3345
80MB (19ms)	64824 - \$3325	64830 - \$3575
110MB (19ms)	64825 - \$3525	64831 - \$3775
320MB (18ms)	64826 - \$4505	64832 - \$4755

CompuAdd 325 Monitor And Hard Drive Options

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- Built-in dual diskette drive controller
- Built-in parallel printer port and two serial ports
- Built-in game port interface (cable required, 48954)
- Three full-size 16-bit and two half-size 8-bit expansion slots
- 80287 math coprocessor socket
- Monographics monitor and adapter
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- New Spinnaker Eight-in-One integrated software
- Real-time clock
- 101-key enhanced keyboard
- Computer paper and ten blank diskettes

Color monitor optional.

Career Starter Kit Monitor And Hard Drive Options

	MGA	CGA	CVGA
No Hard Drive	64716 — \$899	64721 — \$1039	64726 — \$1339
20MB (69ms)	64717 — \$1179	64722 — \$1319	64727 — \$1619
40MB (69ms)	64718 — \$1329	64723 — \$1469	64728 — \$1769

Professional Starter Kit Monitor And Hard Drive Options

	MGA	EGA	CVGA
40MB (69ms)	64747 — \$1495	64752 — \$1845	64757 — \$1935
80MB (19ms)	64748 — \$1905	64753 — \$2255	64758 — \$2345



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51702

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Color Video Graphics Array (CVGA) Combo 14" (13" viewable) color VGA monitor and a CompuAdd VGA graphics card. 51704 **\$539**
Super VGA Combo includes the Mitsubishi Diamond Scan 14" (13" viewable) color VGA monitor and a CompuAdd 16-bit VGA card. 51706 **\$745**

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Color 14" monitor has a 14" (13" viewable) screen. The 0.52mm dot pitch provides for high-resolution up to 640x200. Capable of 16 colors at 15.75KHz. 51100 **\$239**

EGA 14" monitor offers the best value in an enhanced color monitor. Features 14" (13" viewable) screen, 0.31mm dot pitch, and up to 640x350 resolution. 51210 **\$349**

NEC MultiSync® 2A Super VGA color analog monitor with 14" (13" viewable) direct etch screen features up to 800x600 resolution, 0.31mm dot pitch resolution, auto synchronization. 51208 **\$510**

NEC MultiSync 3D Super VGA color analog monitor with 14" (13" viewable) delivers up to 1024x768 resolution with a 0.28mm dot pitch in interlaced mode and limitless color capability. 8514A-compatible. 51209 **\$675**

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71MB MiniScribe (25ms). 47402 **\$569**
80MB Seagate (28ms). 47401 **\$629**

ESDI Hard Drives

90MB Imprimis (18ms, 10Mbit/sec).
47405 **\$899**
150MB Imprimis (18ms, 10Mbit/sec).
47432 **\$1189**
320MB MiniScribe
(18ms, 10Mbit/sec). 47454 **\$1699**
320MB Imprimis (14.5ms, 10Mbit).
47453 **\$1789**
630MB Imprimis
(14.5ms, 15Mbit/sec). 47476 **\$2699**

XT Class Hard Drives

20MB MiniScribe (65ms). 47001 **\$279**
20MB Seagate (65ms). 47002 **\$279**
30MB MiniScribe (65ms). 47100 **\$279**
30MB Seagate (65ms). 47101 **\$299**
40MB MiniScribe (61ms). 47206 **\$379**
40MB Seagate (40ms). 47309 **\$399**
60MB MiniScribe (61ms). 47350 **\$389**

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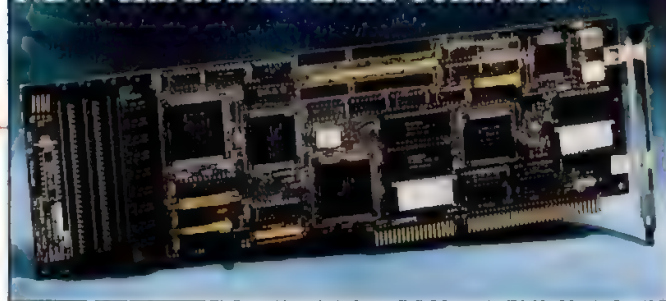
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290 SuperDraft/54 NLQ). 56313 **\$469**
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300 draft/63 NLQ). 56859 **\$339**
Okidata Microline 321 (15" carriage,
300 draft/63 NLQ). 56360 **\$465**
The Star Micronics NX-1000
Rainbow color printer (11" carriage,
144 draft/36 NLQ). 56443 **\$225**

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Panasonic 1124 (11" carriage,
192 draft/63 LQ). 56369 **\$329**
Okidata Microline 390 (11" carriage,
270 draft/90 LQ). 56361 **\$469**
Epson LQ-510 (11" carriage,
225 draft/60 LQ). 56340 **\$339**
Epson LQ-850 (11" carriage,
264 draft/88 LQ). 56334 **\$549**
Epson LQ-1050 (15" carriage,
264 draft/88 LQ). 56333 **\$775**

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1.2MB AT-compatible (gray). 45350 **\$89**

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The B100PC is based on a 12-MHz 68HC000 CPU with 512K RAM and a 2-megabytes-per-second DMA controller. The coprocessor executes code out of its own RAM and handles the communications processing, thus freeing the PC's

Teleos's API gives programmers a good platform on which to turn their ideas into reality.

CPU to do its own chores. A dual-ported RAM system moves data quickly by sharing a block of RAM between the ISDN adapter and the host CPU. This hardware design lets the adapter exploit the full capability of the BRI line.

The NetBIOS-like API supplied by Teleos gives programmers a good platform on which to turn their ideas into reality. The API uses the programming style of NetBIOS, but with slightly different programming structures. A \$2,300 ASK100 package includes the B100PC, the API, and other Unix-like tools (grep, diff, make, sdb, and z). The high-level API lets programmers ignore hardware technicalities and produce programs faster.

A special driver supplied by Teleos adapts the DCA *Crosstalk Mk.4* communications software to the ISDN adapter. The *Mk.4* driver supports four simultaneous X.25 connections on the D channel, as well as B channel bidirectional transfers at 64 kilobits per second.

Teleos does not have a fancy integrated phone management program like some of the other products reviewed here, but its software does include a simple phone book with fields for name, phone number, and comments. Teleos believes that customers would prefer to use their current personal information manager instead of learning a new one. Its NetBIOS-type API gives vendors an easy way to customize their products for the B100PC. However, one limitation of the card is its lack of COM port emulation. If this card emulated a COM port, you could use any standard communications program over the ISDN line.

Teleos opted not to support an ISDN phone with the B100PC. Instead, the adapter gives a standard analog phone the

ability to use ISDN lines. Software included with the B100PC emulates the display and buttons of an ISDN phone when the computer is on. Teleos supplies an external power transformer to power the card and phone while the computer is turned off, but, of course, you lose the display features. Most people will have their computer on at their desks, but if not, the absence of an ISDN set will limit the use of this product.

Other Teleos ISDN products include the ASK200 portable ISDN switch simulator designed for RBOCs and ISDN product developers. Hardware and software developers located in areas where ISDN is not available can use ASK200 to get 80 percent of their design work completed. The Teleos IAP6000 concentrates BRI lines into PRI lines, providing a way for companies to obtain ISDN service in remote locations. Finally, the ASK300 package is Teleos's Unix development system for creating applications to run on the IAP6000.

Teleos's B100PC gives software developers a good hardware and software foundation for building ISDN applications, and it also gives companies fortunate enough to already have ISDN available the ability to use *Crosstalk Mk.4* for multisession file transfers on a BRI line. For those who don't need ISDN display characteristics when their computers are off, this package will more than suffice.

VADIS INC.

Vadis ISDN PC System

Vadis's ISDN PC System furnishes users with a complete communications environment. Like most of the companies in this field, Vadis is young, but it benefits from a legacy. The founders of Vadis are veterans of the now defunct Tele-Compaq. They acquired and tested integrated telephone management, personal productivity, and communications software with a windowed user interface, which they adapted for the Vadis ISDN PC Interface. For \$1,465 you get full ISDN capability, including ICLID and data transfer on B and D channels, as well as e-mail and an integrated calendar.

The ISDN PC Interface card uses an

80C188 processor—a CMOS version of Intel's 80188. The board comes with 512K RAM, expandable to 1MB for use by the on-board processor. Novices will appreciate the absence of switches and jumpers. Another plus is the hardware's ability to emulate either COM1 or COM2. Because the board can emulate a COM port, you can use your favorite communications software over ISDN connections, even though you'll be limited to 19.2 kilobit-per-second transfers.

Vadis supplies a few applications for integrating ISDN into your work environment. Its programs perform the functions found in many personal productivity packages plus some unique telephone management tasks.

The Voice Call Manager is a combination of the familiar electronic phone directory, auto-dialer, and phone call log. The phone directory has entries for addresses and a small notes field. A list-building facility for grouping entries, such as customers, vendors, and sales staff along with DOS-like wildcard searches, makes finding people a simple task. The auto-dialer's flexibility includes 16 different call types, each with room for 32 digits. This gives you plenty of room for accessing your long-distance carrier, entering your personal code, and entering a separate accounting code if necessary.

In addition to all of these benefits, the Voice Call Manager displays all the functions of an ISDN phone on the computer screen. For people using standard analog phones under the *2500 Option*, the computer screen is the only way to use programmable ISDN phone features.

Data calls are administered by the Data Call Manager. Vadis includes TTY, VT-52, VT-100, VT-102, and ADM-3A ter-



FACT FILE

Vadis ISDN PC System

Vadis Inc., 2201 Waterview Pkwy., Richardson, TX 75080; (214) 690-2481.

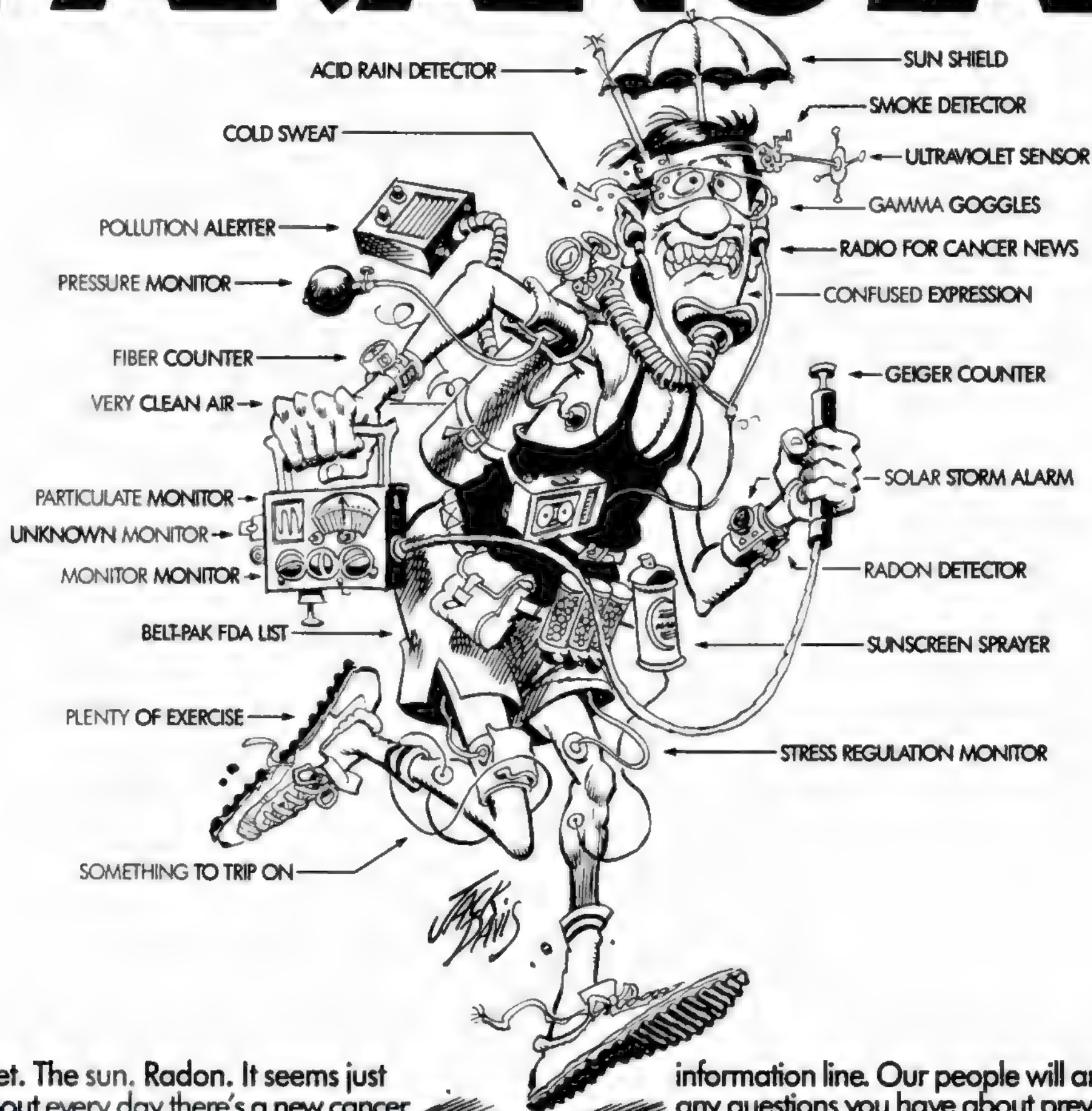
List Price: \$1,465.

Requires: 242K RAM (184K with EMS, 127K with EEMS); DOS 3.2 or later, AT or compatible, or Micro Channel. Access to AT&T 5ESS CO switch with 5E4.X or 5E5 software, or to Northern Telecom DMS-100 CO switch with BMC-28/29 software; BRI S or T interface or U interface with an NT1 (two-to-four-wire converter).

In Short: The Vadis system is a good start for a product with a very popular LAN interface (NetBIOS). Unfortunately, the ISDN PC System's COM port design potentially limits its longevity.

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minal emulators to communicate with other host machines. The terminal program also supports log-on scripts, script learning for automating repetitive tasks, and time-activated scripts for scheduling communications.

Vadis's e-mail facility works in conjunction with the Data Call Manager to provide a useful means of communicating. It has all the basics of an electronic mail

Vadis's NetBIOS

compatibility permits people to use existing LAN applications over the ISDN PC Interface.

program: in-and-out trays, support for multiple To: and cc: entries, and binary attachments. The only notable feature is the way e-mail interacts with external electronic mail services like AT&T, MCI Mail, and TeleMail. Vadis includes some elaborate script files for connecting to these services.

Vadis offers a couple of unique features for integrating the ISDN PC Interface into

your daily routine. One is the ability to use the same software interface regardless of the underlying hardware. Since the *ISDN PC Software System* works with modems in addition to the ISDN PC Interface, companies can standardize and use the same software for ISDN connections and for non-ISDN connections using more traditional analog modem technology.

The NetBIOS compatibility of the Vadis package permits people to use existing LAN applications over the ISDN PC Interface. Programs that use NetBIOS, including LAN operating systems, gateways, and electronic mail, will work over ISDN in addition to working over a LAN. The NetBIOS application has no idea it is working via a dial-up connection 5 miles away. Experienced LAN users will notice that this connection is slower than normal, but it serves as a means for long-distance connections with local network features.

Vadis offers a few complements to its product. The *ISDN PC Software System* works with Hayes-compatible modems and is available separately for \$350, so portions of an organization without ISDN can still use the same software. Also, PS/2 owners need not feel left out: there is a 16-bit Micro Channel version of the card.

Since many phone calls between two people with computers include discussions about data in electronic form, Vadis also

offers the Screen Sharing option, which allows a user to interact with a program that is already running on the other user's computer. As changes are made by each user, both screens are updated. Vadis provides a built-in safety feature that prohibits a user from starting an application on someone else's computer.

The \$264 2500 Option allows you to use a standard telephone on an ISDN BRI line through the adapter. A separate power supply furnishes the necessary power to the card to ring the phone and allow conversations with the computer turned off. You'll probably select this option only in installations where the computer will always be on when the phone is needed.

Vadis's ISDN PC System is a respectable entry into the new ISDN market territory. Its most appealing feature is the NetBIOS emulation, allowing many LAN based programs to immediately operate over the card. Organizations based in several locations at once can take advantage of Vadis's common user interface—even if they do not have ISDN—by using the *ISDN PC Software System* on modems or LAN cards. A good buy for companies wanting the best of both worlds. ■

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine. M. Keith Thompson is a product developer and consultant and a frequent contributor to PC Magazine.



EDITOR'S CHOICE

- NCR ISDN/PCTA
- Progressive Computing ISDN tel/adaptor

There are no weak links in the six-product ISDN terminal adapter chain, so you can make safe buying decisions by choosing the package with features that most closely fit your needs. AT&T's PC/ISDN Platform offers excellent 3270 terminal emulation. The Vadis ISDN PC System's NetBIOS emulation allows you to use your favorite LAN application software. Teleos provides a *Crosstalk Mk.4* driver for high-speed data communications, although it lacks other applications.

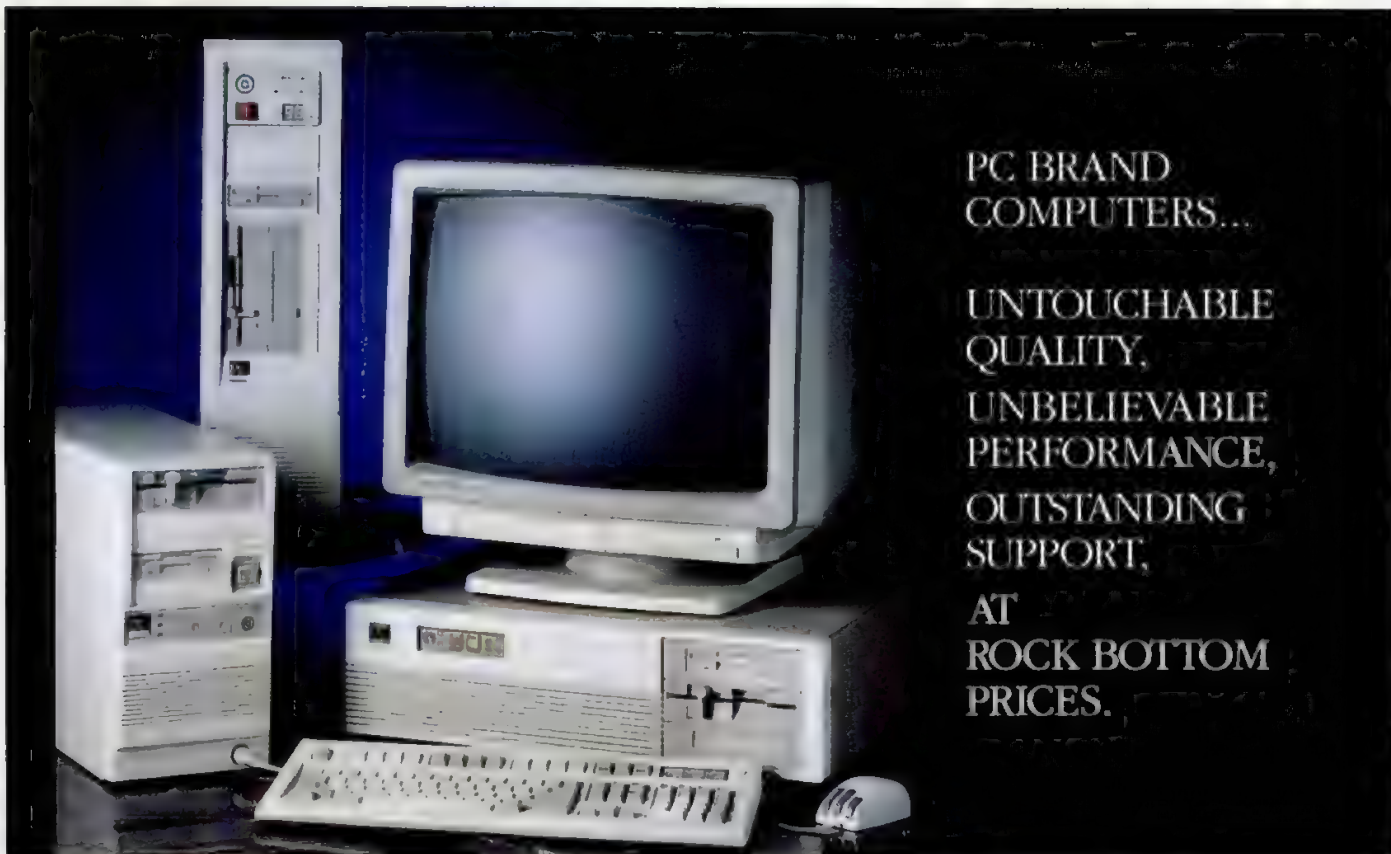
What's more important than what the products do today is what they will do as ISDN matures. As more undiscovered uses of ISDN emerge, the underlying hardware design and

the company behind the product become more vital. AT&T, ICL, and NCR might be expected to lead the way here. However, AT&T is focused on maintaining compatibility with all of its existing equipment and does not interoperate with Northern Telecom's CO switches. ICL's I3 supports AT&T, Northern Telecom, and Siemens switches, but the company's API is for voice only.

The most technically complete and best-supported product is NCR's ISDN/PCTA. Running under OS/2, it can do many things at one time, and it does them all well. The NCR ISDN/PCTA lets you use an inexpensive telephone and detects remote DTMF. The combination of

the power of a digital signal processor with an excellent API gives developers a platform for solving future computing problems.

NCR's product may be a top pick, but its need to run under OS/2 limits its appeal for many users. For DOS followers, the ISDN tel/adaptor from Progressive Computing is a winning alternative. With COM port emulation, users can run their favorite communications software. The product also includes telephone management software for tracking phone conversations. And because Progressive Computing is located in the heart of real-world ISDN (Oak Brook, Illinois), it can be counted on to add new capabilities to the product.



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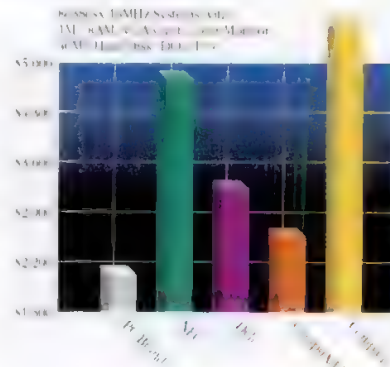
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-PC Magazine, 25MHz 386 PC's, Feb. 14, 1989

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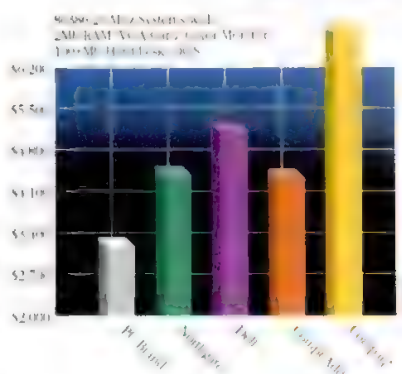
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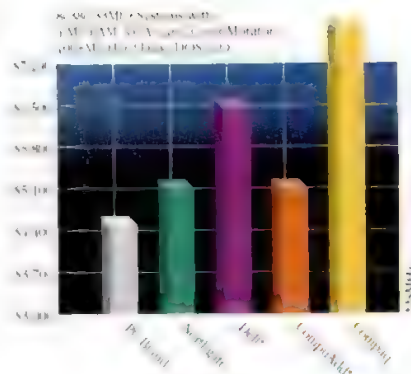
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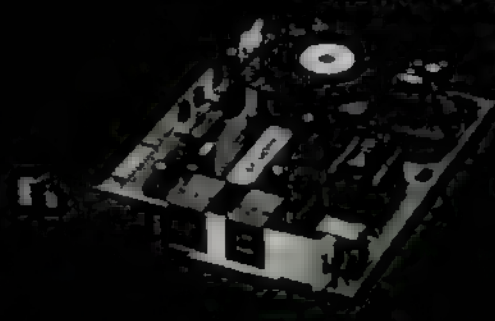
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110MB 28MS	\$2545	\$2745	\$2845	\$3295	\$3495
150MB 17MS	\$3110	\$3310	\$3410	\$3855	\$4055 (ESD)

by
Wolfgang Stiller

Utilities

Is your data protected against the ravages of a well-written virus? Or even against common software bugs, hardware failures, and inexplicable glitches? The fact is that PCs have become an essential part of the corporate environment more rapidly than adequate measures have been developed to protect data and executables from any of these potential problems. Yet who among us can afford to have even a single byte altered on the hard disk he uses at work or at home?

To meet the need for protection, I created PCDATA, the *PC Magazine* Data Integrity Toolkit. Unlike the usual single utility presented in this column, PCDATA is a collection ("toolkit") of coordinated programs and batch files. Working together, they can provide positive assurance that none of your programs or data has been damaged in any way.

The focus of this article will be on using the toolkit to detect and recover from all data integrity threats, including viruses. The sidebar "Threats to Your Data" defines and discusses many of the causes of data or program corruption, such as worms and logic bombs. The sidebar "Data and Program Defense Mechanisms" explores some of the possible protective measures you can take.

ASSESSING THE THREAT

Today, the risk that ordinary programs will destroy your data is many times greater than the threat posed by known computer viruses. The danger from a "super virus" yet to be developed is more remote in time, but far more serious. The most ominous aspect of viruses is that, to date, all of them have been relatively primitive in design. If a method such as that provided by the Data Integrity Toolkit is not widely used, however, a future supersophisticated virus could easily infect millions of PCs and then lie dormant for some years. By the time this virus launched its actual attack, it would be too late to stop the havoc it would wreak.

The viruses that plague us today have

Protect Your Data with PCDATA, the Data Integrity Toolkit

■ Viruses are becoming too sophisticated, and hardware and software glitches and bugs too common, for you to leave your data unprotected any longer.

done everything from simply displaying messages on the screen to making disks unreadable. One of the less primitive viruses, the Pakistani "BRAIN" virus, announces its presence by labeling infected diskettes "BRAIN". Since this provides a warning with the very next DIR or CHKDSK command, it is clearly deliberately done to limit the destructive potential of this virus. Future virus developers may not be so kind!

If, from the standpoint of a single PC, a virus is among the least likely things to corrupt programs or data, is it then acceptable to do nothing or to depend upon techniques that merely make it harder for viruses to infect your system? Definitely not! Even a relatively nonmalicious virus or worm can cause you to waste a day—maybe even days—repairing your system.

More important, the danger from a virus is only one of a number of risk factors. When these other threats to your data are also considered, it becomes clear that some type of data integrity verification—such as that provided by the Data Integrity Toolkit—is required by everyone who values his data.

THE DATA INTEGRITY TOOLKIT

The Data Integrity Toolkit consists of eight highly optimized assembly language programs and 19 batch files. Each program has been written as a general-purpose utility and contains built-in help. The programs run on any IBM-compatible PC, need only 75K of free memory and require DOS 2.0 or later. The toolkit uses the batch files to drive the programs, but each program has additional functions not exploited by the batch files. The sidebar "The Data Integrity Toolbox Commands" lists the programs and explains their syntax, while the sidebar "The Batch Files for the Data Integrity Toolbox" provides a similar treatment for the batch files.

The PCDATA programs and batch files can be downloaded in executable form from PC MagNet, as explained in the sidebar "PCDATA by Modem." Due to space considerations, we are unable to print the source code here. However, if you're interested in examining it, you can download the code as well. You can also get the assembly or BASIC listings by mail or fax by sending a written request with your name, address and fax number (if applicable) to *PC Magazine*, Utilities, One Park Avenue, New York, NY 10016; Attention: Carolyn Falconer. No phone calls please.

Among the eight programs, three pairs of programs work closely together. The first pair is CHKFILE.COM and CFCOMP.COM. CHKFILE reads whatever files are specified by its first parameter, displays the DOS file date, time, and length, and then uses separate high-speed algorithms to compute and display two 16-

Utilities

bit check values for each file. These check values provide a characteristic signature for each file. Any change to these files will result in a different signature. CHKFILE produces DOS standard output, which can be redirected to a file. CFCOMP can compare these redirected files and report exactly which files have been changed, added, or deleted.

The second program pair, CHKFILEC.COM and CFCOMPC.COM, work very much like CHKFILE and CFCOMP. The difference is that the output of CHKFILEC is written directly to a file in a compressed, encrypted, and self-checking form. If a system glitch should corrupt a CHKFILEC report file, CFCOMPC will detect it.

The third pair, CHKBOOT.COM and LODBOOT.COM, check the DOS boot sectors and hard disk partition tables for corruption. During initialization, CHKBOOT creates sector reload files and a parameter file that contains check data calculated for the boot and partition sectors. All these files contain internal self-check information that will detect any corruption of the files themselves.

The last two programs, MIRROR.COM and XALL.COM, were written to facilitate batch file operation of the toolkit. MIRROR allows a batch file to "mirror" the directory structure of one disk onto another. XALL simply executes a program or batch file in all subdirectories. It is similar to the *PC Magazine* SWEEP utility, except it runs roughly twice as fast and has special error-handling abilities tailored specially for the Data Integrity Toolkit.

WORKING TOGETHER

The toolkit uses the batch files to drive the programs, although the batch files don't exploit all their functions. SCANMAX.BAT, for example, makes a complete check of everything on your PC. Run SCANMAX and CHKBOOT reads the boot and (optionally) the partition sector, calculates the associated check data, and compares it with that stored in the parameter file created earlier. If the boot or partition sectors ever become damaged, LODBOOT can be used to restore them by using the associated sector reload file.

Next, XALL.COM is used to execute CHKFILEC in all directories of the disk, reading each file and recording its check data. One report file containing check data

THREATS TO YOUR DATA

by Wolfgang Stiller

To guard the integrity of your data, it's important to begin by understanding the nature of the dangers it must face. The most publicized threats are software-based attacks, often lumped together under the term *viruses*. Although they have been oversensationalized by the media, the danger posed by computer viruses is indeed real.

But while a virus may never attack your PC, it is almost inevitable that ordinary system glitches will sooner or later corrupt data or programs on your disk. The *PC Magazine* Data Integrity Toolkit allows you to detect and address all of the threats described below.

LOGIC BOMBS

Like a real bomb, a logic bomb lies dormant until triggered by some event. The trigger can be a specific date, the number of times a program is executed, a random number, or even a specific event such as deletion of an employee's payroll record. When the logic bomb is triggered, it will usually do something unpleasant. This can range from changing a random byte of data somewhere on your disk to making the entire disk unreadable.

Changing data on a disk at random is the most insidious kind of attack, since for most users it would do much damage before it was even detected. The *PC Integrity* Toolkit will not stop a logic bomb from exploding, but it will report exactly what damage was done, enabling you to recover. As discussed in the sidebar "Data and Program Defense Mechanisms" there is unfortunately no way to prevent a well-written logic bomb from doing its initial damage to your system.

is written for each directory. The check data consists of the filename, check value 1, check value 2, file size, and the DOS time and date stamps. After comparing the newly created check data with the prior check data, CFCOMPC reports any file changes, additions, and deletions.

The two check values that are computed by CHKFILEC form the basis for detecting corruption. The DOS directory information (file size, time, and date) alone is not sufficient to detect file damage, since

TROJAN HORSES

Named for the wooden horse that smuggled Greek soldiers into the city of Troy, a Trojan Horse program is a delivery vehicle for putting destructive code (such as a logic bomb or a virus) into a computer. The Trojan Horse appears to be a useful program of some type, but when a certain event occurs, it does something nasty and often destructive to the system.

VIRUSES

Viruses, technically speaking, are programs that place self-replicating code in other programs, so that when those other programs are executed, even more programs become "infected" with the self-replicating code. Viruses are typically slipped into computers initially by means of a Trojan Horse program. Once there, the virus infects other useful programs, so that absolutely any piece of executable code can suddenly become a Trojan Horse for the virus.

There are three things often misunderstood about viruses. The first is that both the infection and the actual destructive attack may be event-driven. Thus, simply running a program a number of times or monitoring its performance provides no assurance that it is virus-free.

The second is that viruses can potentially bypass DOS—or even the BIOS—both to infect and to do damage. This means that a sophisticated virus can be made impossible to detect with normal monitoring techniques (intercepting BIOS and DOS calls). Such a virus might then go resident itself and make infected programs appear normal by intercepting DOS and BIOS read requests to the infected program files.

a virus, software error, or hardware error could write directly to disk sectors without updating the DOS file information. Indeed, one well-known virus trick is to modify COMMAND.COM with a jump to code that is hidden in its stack area. This produces no discernible change to COMMAND.COM as far as the DOS information is concerned.

The reason the toolkit records the DOS data at all is to make it easier to differentiate between legitimate file changes and

The third misunderstanding is that, contrary to popular conception, you are no more likely to get a virus from software downloaded from a bulletin board than from a commercial vendor.

Of all threats to the integrity of your data, viruses are by far the most difficult to detect and to recover from. The procedure outlined in this article can detect the infection attempts of any virus no matter how well written. To provide this degree of protection, the procedures outlined here must be followed precisely.

WORMS

A worm is a self-reproducing program that does not infect other programs (as a virus does), but instead simply creates copies of itself. This is usually seen on networks and on multiprocessing operating systems, where the worm creates copies of itself that are also executed. Each new copy will create more copies, quickly clogging the system. The so-called ARPANET/INTERNET virus was actually a worm. It created copies of itself through the ARPA network, eventually bringing the network to its knees. It did not infect other programs as a virus would.

SOFTWARE BUGS

These are a much more likely threat to your PC than virus attacks. We run our PCs today in a complex environment. There are many resident programs running apparently at the same time and many versions of DOS and BIOS and device drivers out there. With such a profusion there are bound to be some sneaky bugs waiting to bite us. Any time a program goes haywire, there's a risk that it will damage on-disk information. If you have just undeleted a file, did you really get all the correct

clusters back in the right order? When CHKDSK "fixes" your disk for you, wouldn't it be nice to know exactly what it did? The PC Integrity Toolkit enables you to answer these questions easily.

HARDWARE AND POWER FAULTS

These also are all too common. What happens when your PC is busy writing data to disk and the lights go out? Is it all OK? Quite possibly not. If your disk drive is starting to fail, you can have the same problem. Unfortunately, regarding disk failure it's not a question of if, but a question of when. There are tools (such as *The Norton Utilities*, *Mace Utilities*, *PC Tools*, and so forth) that assist in recovery from disk problems, but how do you know all the data is OK? They will not always save your data.

FINGER CHECKS

Finger checks are typos and the "Oops! I didn't mean to do that" sort of errors, and these, too, are an all-too-frequent source of data corruption and loss. What happens most commonly is that you intend to delete or replace one file but get another. If you're using wildcards, you may be in for a really "wild" time. "Hmmm . . . I thought I deleted all the *.BAK files, but they're still here . . . Something was deleted . . . what was it? . . . or was I in the other directory?"

USER-CAUSED DAMAGE

Finally, among our catalog of risks, someone may accidentally or intentionally delete or change a file on your PC when you're not around. If your PC is not kept locked in a safe, this is always a risk, and it increases as more and more people start using PCs. ■

those caused by some type of system corruption. The combination of information recorded in the check files effectively makes it impossible for a virus or a system glitch to modify a file in a way that can't be detected. The check files are stored on a floppy so that a virus cannot attack the check information directly.

INITIALIZING THE TOOLKIT SYSTEM

For simplicity's sake, the instructions that follow assume that you are checking your

hard (fixed) disk C: and that you will be using floppy drive A:. Ideally, you will want to protect all your drives, but those you boot from must receive first priority and are the ones whose partition and boot sectors you will check.

The four basic steps that are used to get the Data Integrity Toolkit up and running are establishing initial system integrity; creating a rescue system; installing the data integrity toolkit; and initializing the integrity check files.

STEP 1: ENSURING SYSTEM INTEGRITY

Although the chances are slight, it is always possible that a virus may already have infected your system. On this worst-case assumption, we cannot safely install the toolkit programs, since the virus can intercept the toolkit's own BIOS and DOS calls. We need to begin with as clean a system as possible.

Turn off your PC. Then turn it on and boot it from a good diskette copy of DOS. If there is any chance that this copy could be damaged or infected, take the time to get out your original DOS install disks, execute `FORMAT A: /S` on a new diskette to make it bootable, and copy the DOS files you normally use onto it.

Now reinstall DOS from the diskette or compare all its files with those on your hard disk. Frankly, to be *absolutely* sure that your partition and boot sectors are not already infected, you would have to run `FORMAT /S` and `FDISK` on your hard disk. This entails backing up and then restoring all your (probably uninfected) files, of course, and it's probably not worth the trouble unless you actually have some indication of infection (such as a volume labeled BRAIN).

If there is evidence of infection, one alternative would be to locate a noninfected hard disk with the same DOS version and use `CHKBOOT` to compare the boot sectors of the two machines. If `CHKBOOT` shows the sectors to be OK, then all is well. Otherwise the sector file—`@@BOOT.SCT`—and optionally `@@PARTIT.SCT`—will have to be copied from the clean system to the suspect one. After booting the suspect PC from a clean floppy, `LODBOOT` can be used to reload the suspect sectors.

Now change to the drive you want to check—in this example, drive C:—and execute `CHKDSK` to detect and correct any directory or FAT problems.

STEP 2: CREATE A RESCUE SYSTEM

In case a virus ever does attack your PC, or if a glitch damages an important file, it is vital to ensure that you can get your PC up and running so that you can undertake the necessary repairs. The rescue system created in this step will give you the assurance that no matter what happens, you can boot a healthy system and recover whatever has been damaged.

Make sure, of course, that you have adequate backups of all files. Always save your original program install diskettes and *their* backups. And only copy programs



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DATA AND PROGRAM DEFENSE MECHANISMS

by Wolfgang Stiller

What follows is a quick review of some of the many different corruption and viral countermeasures in wide use today.

VIRUS TELLTALE SCANNING

Once a nonmutating virus has been detected, it is possible to write programs that look for telltale code that's characteristic of the virus and then neutralize that code. This obviously works only for known, preexisting viruses. If a virus mutates, that is, changes each copy of itself slightly, then the scanning technique may not work.

So far, no genuine cases of mutating viruses have been detected. However, another, simpler way for a virus to effectively mutate is for a programmer to change it after its initial release, so as to alter its behavior. It would be easy, for example, to modify the Pakistani "BRAIN" virus so that it did not put its telltale BRAIN in the disk label.

SYSTEM MONITORING

This technique is particularly useful for defusing logic bombs and Trojan Horses. Using this method, the antiviral code monitors the operating system calls that write to disk or do other potentially threatening things, such as make a program resident. There is, however, no way to intercept direct branches into low-level code or to intercept direct input and output instructions done by the virus itself.

There is at least one reported case in which a virus modified the interrupt 13h and 26h vectors to disable any monitoring code. It is important to realize that reliance on interrupt-monitoring is a risky technique. Moreover,

some products that use this technique are so annoying to use (they generate more messages than people will tolerate) that some users consider the cure worse than the disease! A monitoring product would be a useful adjunct to the PC Integrity Toolkit, not as protection against viruses, but as protection against some of the more simple-minded logic bombs that get passed around from time to time.

DETECTION

The PC Magazine Data Integrity Toolkit does provide the means to *detect* viruses. To do its job, a virus must do two things: first, it must infect other programs, and second, it must undertake some destructive act that usually involves disk writes. A virus can be detected at either of these two points by checking for disk changes. Detection is the most practical of the techniques, since it not only allows you to stop the spread of viruses but also to detect data corruption resulting from any other cause. It's not certain that you will *ever* be attacked by a virus, but it's more than likely that your data will at some time be damaged by some other source, such as a software bug.

VACCINATION

This is actually a type of detection technique in which the check data and the checking code are planted in the program itself. When the program is executed, the check code first computes the check data and compares it with the stored data. This technique can be circumvented, however, by a virus that can modify the self-checking code or the check data.

ENCRYPTION AND ENCAPSULATION

Although encrypting executable files makes life harder for viruses, it cannot stop them completely, since there will always be *some* unencrypted code around—the boot sector, BIOS, DOS, device drivers, and so on—for the virus to feed upon. Putting executable code into a hardware write-protected device will protect all the programs on that device. DOS-in-ROM (Read Only Memory) similarly provides a limited degree of protection, though other programs remain vulnerable to infection. Software that is now being made available in ROM cartridges—most notably for laptop machines—is an example of hardware-related protection.

CAN VIRUSES BE PREVENTED?

Hardware techniques can in principle protect against viruses. Pure software techniques will probably never be able to deter all viruses. There are all sorts of schemes that make it *more difficult* for a virus to penetrate your system, but none can entirely eliminate the threat from a well-executed virus. For each software-based solution, there is a software-based way around it.

But while *prevention* of viruses may not yet be possible, *detection* is. Detection techniques, carefully applied, can spot all viruses, no matter how tricky. And if viruses are detected before they spread, the most serious aspect of the virus threat is eliminated. Detection, through the kind of data integrity checking that PCDATA provides, is the best insurance most of us can afford. Practiced widely, it can defuse even the threat from a virus that insidiously spreads to millions of PCs and then, years later, becomes an active plague. ■

from your install disks; otherwise they, too, could become infected by a virus. But most important, decide on a backup policy and follow it! Having *two* full backups of all files on your hard disk is minimal acceptable insurance. Then, by doing regular incremental backups (only modified files), it will be a relatively painless task to recover fully from any type of failure. Be sure, too, that you have a robust backup and re-

store program—one that can tolerate a disk error without aborting the entire restore.

Create three bootable floppies for the toolkit files using your clean copy of DOS. Make one of these of the highest capacity your drives support and label it Check. Label the other two Recovery and Diagnose respectively.

An important warning: *never* put your PCDATA (toolkit) diskettes in a drive un-

less you are about to boot from one of them. A virus could contaminate the diskettes even though—supposedly—no program is using them. The Pakistani BRAIN virus has just this capability, for example.

Copy your disk restore program to the diskette labeled Recovery. It's helpful to copy your backup log to this diskette as well, since you will use it to recover from a disk failure or a virus attack. If your back-

Utilities

CHKFILE

COMPLETE LISTING

CHKFILE 1.0 - PCDATA TOOLKIT (c) 1990 Ziff Communications Co.
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File Name + Extension:	Check Val1:	Check Val2:	File Size:	Update Date:	Update Time:
-----	-----	-----	-----	-----	-----
CHECK.BAT	083B	936C	A1E	11/29/89	00:34:56
CHECKD.BAT	EDF5	A360	538	06/17/89	19:13:28
DELFILES.BAT	7A71	8330	199	06/17/89	20:27:54
DSPLOG.BAT	A3FA	15BE	8A0	11/29/89	00:31:18
DSPREP.BAT	E578	B883	40D	06/17/89	02:53:12
FASTRUN.BAT	AF9D	C875	D1C	11/29/89	00:32:02
INITDIR.BAT	09B6	1F81	2A	06/17/89	22:50:04
INITSYS.BAT	048F	E322	FF2	11/29/89	00:33:06
RELODB.BAT	B47D	0F5B	7F0	11/29/89	00:37:46
SCANDIR.BAT	4DB1	5A5B	EDB	11/29/89	00:33:50
SCANDIRD.BAT	5E0E	6B32	144	06/17/89	20:51:32
SCANMAX.BAT	50EB	662D	109B	11/29/89	00:39:06
SCANRDR.BAT	2982	4A47	AB	06/17/89	12:01:34
SCANRFDR.BAT	2D7F	6438	BB	06/17/89	22:41:22
SCANSYS.BAT	0602	5C3D	FFD	11/29/89	00:39:22
SCANSYSD.BAT	C829	BDD2	5BA	11/29/89	00:39:42
SETUPF.BAT	08B4	D203	1DE6	11/29/89	00:44:14
SETUPH.BAT	F530	D3B6	1925	11/29/89	00:46:02
SETUPH2.BAT	1459	5693	198A	11/29/89	00:48:00
CFCOMP.COM	E7A1	243F	AAD	11/28/89	22:57:52
CFCOMPC.COM	901F	C761	C39	11/28/89	23:05:28
CHKBOOT.COM	020E	8530	1996	11/28/89	23:56:58
CHKFILE.COM	1185	0ABF	8C0	11/28/89	23:19:12
CHKFILEC.COM	4691	9B4B	952	11/28/89	23:01:10
LODBOOT.COM	C617	B808	9E5	11/29/89	00:14:10
MIRDIR.COM	814D	34C5	4A6	11/28/89	23:27:26
XALL.COM	5D46	F6B0	3C9	11/28/89	23:33:24
SETUPSM2.CPY	50CD	653D	109B	11/29/89	00:48:52
SETUPSMF.CPY	506C	C916	1099	11/29/89	00:49:22
))INTC.LOG	E876	CA98	260	11/29/89	07:09:12
))INTC2.LOG	E4E0	8B6B	260	11/29/89	07:23:40
))INTCF.LOG	E5F2	9D4A	260	11/29/89	07:25:52
))INTR.LOG	1168	B4D2	2C4	11/29/89	07:04:24
))INTR2.LOG	108D	81E8	2C4	11/29/89	07:28:00
))INTRF.LOG	0744	89BB	2AB	11/29/89	07:29:56

Figure 1: This typical CHKFILE report can be used to ensure that your copies of the Data Integrity Toolkit batch files and executables have not themselves been corrupted.

up program does not maintain a backup log, it's worthwhile to use a text editor and create one; just jot a note every time you do a full or partial backup. You'll also need 70K of free space on this disk. If you don't have it, use a higher-capacity diskette or create an additional one.

Copy your diagnostic and disk utility programs to the Diagnose diskette. This will provide a safe way to run hardware tests on a system that may be infected with a virus.

STEP 3: INSTALLING THE TOOLKIT

This step customizes and installs the PCDATA software on the Recovery and Check diskettes that will be used to test the integrity of the primary boot disk and to recover from problems that may arise.

If you use a hard disk, copy the toolkit files into a subdirectory of the drive from which you normally boot—the most important drive to check. Then change to this directory and verify that you have a valid

set of files by executing the command

```
CHKFILE *.*
```

If your machine lacks a hard disk, copy the toolkit files to a subdirectory on the Check diskette. If the report on your screen matches the one shown in Figure 1, you have all the files, and their check values and sizes are correct. Next, copy CHKDSK.COM and MORE.COM from your original DOS disk onto both your Check and Recovery diskettes.

Return now to your toolkit directory. The vast majority of you will probably be protecting a system with a hard disk. But if you do not have a hard disk on your PC, put the check disk in drive A: and the Recovery disk in drive B: and execute

```
SETUPF A: B:
```

You can do this even on systems that have only one floppy drive. In this case, DOS

will pretend that there is a drive B: and tell you when to insert the disks that would normally be put into it. If you have just one drive, however, do your disk swaps only when DOS tells you to, rather than when the batch file requests a swap.

If you have one or more physical drives and your system boots from the first, put the Recovery disk in drive A: and execute the command

```
SETUPH A:
```

If your system boots from a second physical hard disk, enter

```
SETUPH2 A:
```

These batch files will use CHKBOOT to check your current boot and partition sectors and create parameter and reload files. The message

```
Partition sector not processed.  
Hard disk not found.
```

is normal for systems that have no hard disk. The sector reload files and all other needed toolkit files will be copied to the Recovery diskette.

The batch file will now instruct you to insert the Check diskette. The CHKBOOT parameter file and other needed files will be copied to it. These batch files include a step that checks the files copied to the Recovery and Check diskettes to make sure of their integrity. You should not see any Data Integrity Toolkit files listed as deleted or changed. It is normal, however, for the sector files (@@BOOT.SCT and @@PARTIT.SCT), CHKBOOT.PRM, COMMAND.COM, MORE.COM, CHKDSK.COM, and the two system files (IBMBIO.COM and IBMDOS.COM) to be reported as changed at this point. (On non-IBM versions of DOS, the system files will have different names.)

If any of the toolkit files are reported as deleted, check that you have enough room on your diskette and that all the copies work. The message

```
File totals Unequal
```

is normal.

If the disk to be checked has more than 5,000 files or 85 directories, you will probably run out of space using a normal (DSDD) 360K disk as your Check diskette. Using a higher-capacity diskette is the best solution. A 720K diskette will ac-

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THE DATA INTEGRITY TOOLBOX COMMANDS

by Wolfgang Stiller

CFCOMP

CFCOMP.COM performs a high-speed comparison using output (report) files created by CHKFILE. CFCOMP then displays which files have been changed, deleted, or added between the creation of the OLD and NEW report files. The syntax is

```
CFCOMP oldfile newfile [/C] [/O]
[/P]
```

where *oldfile* is the report file originally created by CHKFILE.COM and *newfile* is a report file subsequently created by CHKFILE.COM.

/C reports changes only. When this option is selected, CFCOMP ignores additions or deletions from file list.

/O uses only check fields and file size in comparing files. DOS time and date stamps are ignored.

/P pauses after each page of output if non-matching files are detected.

CFCOMPC

CFCOMPC.COM is similar in its operations to the CFCOMP.COM program described above, but it works on the compressed report files created by CHKFILEC rather than on those created by CHKFILE. Its syntax is

```
CFCOMPC oldfile newfile [/C] [/O]
[/P]
```

The parameter descriptions are similar

to those listed above for CFCOMP.COM.

CHKBOOT

CHKBOOT.COM checks the integrity of the DOS boot sectors and hard disk partition tables (sectors). On first execution, or with the /I parameter specified, CHKBOOT writes check values to a parameter file and creates reload files for the boot and partition sectors. During subsequent executions, CHKBOOT uses the information that has been recorded in the parameter file to check the DOS boot record and the partition sector for any changes. All the files written contain self-check information. The syntax is

```
CHKBOOT [filespec] [/B] [/H] [/I]
[/P] [/2]
```

where *filespec* lets you specify a file other than the default CHKBOOT.PRM as the parameter file.

/B checks the boot record on the current DOS disk for any changes.

/H presents detailed help information.

/I forces initialization. When this switch is included, CHKBOOT follows the procedure described above for a first execution. The boot and partition sectors are copied to files @@BOOT.SCT and @@PARTIT.SCT for reload by LODBOOT.

/P checks to see if there are any changes in the partition sector on the

first physical hard disk drive.

/2 checks partition sector on the second physical drive. Note that /P and /2 may not be specified together.

At least one of the parameters, /B, /P, /2, or /I, must be entered. If /I is entered, then /B and /P are ignored (/2 is honored). If the parameter file does not exist, CHKBOOT will automatically initialize and create it.

CHKFILE

CHKFILE.COM calculates two unique, algorithmically based check values for each file. These are displayed, together with file size, update date, and update time. The check data is used to determine whether the file has been modified in any way. CHKFILE output can be redirected to a file used by the CFCOMP program for making comparisons. If entered without a *filename*, CHKFILE produces a help display of its syntax:

```
CHKFILE [d:] [path] filename [/D]
[/I:aa] [/T] [/1] [/2]
```

where *filename* specifies the file(s) to be read and checked. Wildcard characters can be used and a drive and directory specified.

/D displays directory entries as well as regular files.

/I:aa ignores filenames beginning with two *aa* characters.

/T generates cumulative total file-check values (both check value 1 and value 2) for all files checked.

/1 uses the alternate algorithm to cal-

commodate 10,000 files and 300 directories, with room to spare. If this still isn't enough, you can create an additional Check diskette. By not putting the toolkit files and DOS on the additional disk, you'll gain an extra 124K of space.

Since this second Check diskette is non-bootable, you can put it in a different physical drive than you use for your normal Check diskette. Label this one "Check-mt" ("mt" for "empty") and copy DELFILES.BAT from your toolkit files onto it. If you are going to employ it to check a bootable drive on your hard disk, copy CHKBOOT.PRM to it from your regular

Check diskette as well.

A 360K Check-mt diskette will handle 5,000 files and 150 directories. Note that in order to use Check-mt diskettes, you must execute FASTRUN.BAT before running SCANMAX or SCANSYS (which performs only the file checking).

The AUTOEXEC.BAT files and the CONFIG.SYS files should not be necessary on any of the PCDATA diskettes unless your system must run customizing files, such as special device drivers, at boot-up. Be extremely careful *not* to add any TSRs or directories to your path. It is absolutely vital that no unforeseen pro-

grams execute during the integrity check.

You may wish to add a routine check of the boot sectors to your normal AUTOEXEC.BAT file. To add this optional bit of extra security, use an ASCII editor or word processor and type

```
CHKBOOT /B /P
```

in your AUTOEXEC.BAT file. Use /2 rather than /P if you boot from a second physical drive. Copy CHKBOOT.PRM to the same root directory as your normal AUTOEXEC.BAT file or use the CHKBOOT *filespec* parameter if you want

culate check value 1.

/2 uses the alternate algorithm to calculate check value 2.

CHKFILEC

CHKFILEC.COM is similar in its operations to the CHKFILE.COM program described above, but it creates compressed report files for use by

Check data is used
to determine
whether a file has
been modified.

CFCOMPC.COM. In its syntax

```
CHKFILEC filespec1 filespec2 [/D]  
[/I:aa] [/T] [/1] [/2]
```

filespec1 lists the file(s) to be read and checked; *filespec2* specifies the compressed report of file-check data for use by CFCOMPC. Wildcards can be used and a drive and directory specified.

Other parameter descriptions are similar to those listed above for CHKFILE.COM.

LODBOOT

LODBOOT.COM reads the boot sector or partition sector reload file created by CHKBOOT, verifies that it has not

been corrupted, and then reloads the appropriate code onto a hard disk whose DOS boot sector or partition sector (table) has been damaged. Its syntax is

```
LODBOOT [/B] [/P] [/2]
```

/B reloads the boot record from the file @@ BOOT.SCT created previously by an execution of CHKBOOT /I.

/P reloads the partition sector onto the first physical hard disk drive from file @@ PARTIT.SCT.

/2 is similar to /P, but writes to a second physical fixed disk.

Note that only one of the above parameters may be specified at a time.

MIRROR

MIRROR.COM copies the currently logged directory structure onto another specified disk. MIRROR tries to use the same directory name on the second disk and to change to it. The syntax is

```
MIRROR d:
```

where *d:* specifies the drive onto which the current directory is to be mirrored.

XALL

XALL.COM executes any command in the current directory and in all sub-directories below it. The syntax is

```
XALL command
```

where *command* may be a batch file, program, or DOS command. Its directory should be in the DOS PATH. ■

to specify another file. Although this added precaution will not catch all boot-record infections, it will provide early warning of the more simple-minded viruses and immediate detection of all other types of corruption.

STEP 4: THE INTEGRITY CHECK FILES

It's now time to create the actual information that the toolkit will need to confirm the consistent state of your system or to report any anomalies. In order to check your hard disk drive C: (per our example), make sure that it has at least 75K of free disk space, put the Check diskette into drive A:,

and enter the following:

```
FASTRUN A:
```

FASTRUN creates a directory called @@PCITK.TMP on drive C: and then it copies all the programs that it needs (including COMMAND.COM) from the Check diskette to this directory. FASTRUN also sets the DOS PATH and the COMSPEC to use files only from this directory. Loading programs and batch files from this directory will be much faster than if you load them from a floppy. If you have created a Check-nt diskette, insert it in

drive A: at this point and enter

```
INITSYS A:
```

If you have chosen not to use FASTRUN, execute

```
A:INITSYS A:
```

with the Check-nt diskette in drive A:.

INITSYS uses XALL to execute the programs MIRROR and CHKFILEC in all directories. MIRROR creates a directory on the floppy diskette with the same name as the one being checked. CHKFILEC then reads each file in the hard disk directory and writes a compressed report file (con-

Be especially vigilant
when it comes to DOS-
related files. If any
of these are changed,
it's a good bet that
you've got some type
of system corruption.

taining the calculated check information) in the corresponding diskette directory. If FASTRUN was executed, INITSYS will delete the @@PCITK.TMP directory and its files when it's through.

MAKING ADDITIONAL CHECK DISKETTES

For each additional hard disk drive you intend to check, create another Check diskette. Execute `FORMAT A: /S` on each additional diskette and copy all .COM and .BAT files from the original Check diskette to each of these disks. If any of the additional drives are bootable, format two new disks for each (using `FORMAT A: /S`) and create new Recover and Check diskettes for each of them as well—just as you previously did for drive C:. Clearly label the diskettes you have created, with the type (Check or Recovery) and the name of the drive on which they will be used.

RUNNING THE TOOLKIT

The most direct way to use PCDATA is to boot from the Check diskette and then, at

THE BATCH FILES FOR THE DATA INTEGRITY TOOLBOX

by Wolfgang Stiller

CHECK

CHECK.BAT tests all files in the current directory that match the specified *filespec* and compares the results with those stored on the Check or Check-mt diskette(s) in drive A:. The syntax is

```
CHECK filespec A:
or
A:CHECK filespec A:
```

Changes to the files will be reported, but additions and deletions will not be reported.

The second form of the command is for use without FASTRUN.

CHECKD

CHECKD.BAT checks all files matching the specified *filespec* and compares the results against check data stored in the))A.LOG file in the same directory. The syntax is

```
CHECKD filespec
```

CHECKD is used with SCANSYSD and SCANDIRD.

DELFILES

DELFILES.BAT is invoked by SCANSYS, SCANMAX, and INITSYS to remove the))PCITK.TMP file and directory. Its syntax is

```
DELFILES
```

DSPLOG

DSPLOG.BAT uses CFCOMPC to read the report file (*filename*) produced by CHKFILEC. The syntax is

```
DSPLOG filename
```

If the file is not in the correct format, DSPLOG will display it as if it were a CHKFILE-produced report file.

DSPREP

DSPREP.BAT displays the file))SYS.LOG in the current disk's root directory. Its syntax is

```
DSPREP
```

SCANMAX and SCANSYS write their report of file changes in))SYS.LOG. The DSPREP file takes no parameters.

FASTRUN

FASTRUN.BAT copies needed files from the disk in drive A: to a directory called))PCITK.TMP on the currently logged disk. The syntax is

```
FASTRUN A:
```

If the current disk is a hard disk, this will speed up checking on that disk. The batch files SCANMAX, SCANSYS, INITSYS, CHECK, and SCANDIR all take advantage of FASTRUN.

INITDIR

INITDIR.BAT is used internally by INITSYS. Its syntax is

```
INITDIR
```

INITSYS

INITSYS.BAT is used to initialize the Check and Check-mt diskettes. Put these disks in drive A:. The syntax is

```
INITSYS A:
or
A:INITSYS A:
```

The second form of the command is for use without FASTRUN.

RELODB

RELODB.BAT reloads the boot record onto the current disk, using the @@BOOT.SCT reload file located on the Recovery disk in drive A:. Use

```
RELODB A:
```

SCANDIR

SCANDIR.BAT checks all files in the current directory and compares the results with those stored in the report file on the Check or Check-mt diskette in drive A:. The syntax is

```
SCANDIR A:
or
A:SCANDIR A:
```

regular intervals, to run either SCANMAX or SCANSYS. These batch files will use only programs from the floppy diskette, so a virus can't interfere with the integrity-checking process.

SCANMAX will do a CHKDSK /F to make sure the basic FAT and directory structure is sound. If CHKDSK does report a problem, don't worry! SCANMAX will shortly report exactly what has been added, deleted, or changed, and you will be given the option of allowing the file to fix it.

SCANMAX next invokes CHKBOOT to determine whether your boot record and partition sectors are undamaged. SCAN-

MAX then uses XALL and CHKFILEC to read every file on your hard disk and uses CFCOMPC to compare it to the recorded file integrity information.

The completed report will be written to a file called))SYS.LOG in the root directory of the drive being checked. If any files have been changed, the updated report file will be written to the corresponding directory on the Check floppy diskette. You can use your favorite file viewer, text editor, or the batch file DSPREP to display the results of the integrity check.

You will see a listing of any files or directories that have been added, deleted, or changed. If a file has been changed, both

the old and the new information for that file will be displayed. This allows a comparison to determine whether the file change was due to some type of corruption or whether it was the result of legitimate operations.

EVALUATING SYSTEM CHANGES

How can you differentiate between good (authorized) and bad changes? First, of course, only those files that are meant to be modified by the programs you use should show up as changed. Finding that any other files have been changed, added, or deleted is a sign of potential corruption. Most programs make it pretty clear which files

Any changes to files are recorded on the Check diskette.

The second form of the command is for use without FASTRUN.

SCANDIRD

SCANDIRD.BAT works like SCANDIR except it compares against a))A.LOG report file that must be in the same directory as the files being checked. Its syntax is

```
SCANDIRD
```

SCANDIRD takes no parameters.

SCANMAX

The SCANMAX.BAT batch file checks the boot and (optionally) the partition records for any changes and performs a CHKDSK. Then it checks all files on the current disk against the check information on the Check or Check-mt disk that is located in drive A:. Any changes in files are recorded on this diskette. The syntax is

```
SCANMAX A:  
or  
A:SCANMAX A:
```

The second form of the command is for use without FASTRUN.

SCANRDR

SCANRDR.BAT is used internally by SCANSYSD. Its syntax is

```
SCANRDR
```

SCANRFDR

SCANRFDR.BAT is used internally by SCANSYS. The syntax is

```
SCANRFDR
```

SCANSYS

SCANSYS.BAT performs a CHKDSK and then checks all files on the current disk. All check information must be on the Check or Check-mt disk, which is located in drive A:, and any changes in files are recorded on this diskette. Its syntax is

```
SCANSYS A:  
or  
A:SCANSYS A:
```

The second form of the command is for use without FASTRUN.

SCANSYSD

SCANSYSD.BAT is similar to the SCANSYS.BAT batch file, except that SCANSYSD uses))A.LOG report files, which must be in each of the directories on the disk. The syntax is

```
SCANSYSD
```

SCANSYSD can also be used initially to create all these report files. SCANSYSD takes no parameters.

SETUPF

SETUPF.BAT creates the Check and the Recovery diskettes on floppy disk

systems. The syntax is

```
SETUPF A: B:
```

Drive A: should contain the toolkit files and drive B: should contain a diskette created with `FORMAT B: /S`.

SETUPH

SETUPH.BAT is used to create the Check and Recovery diskettes on systems that boot from the the first physical hard disk. The currently logged directory must contain the toolkit files.

```
SETUPH A:
```

Drive A: must contain a diskette formatted with `FORMAT A: /S` that will be used for Check or Recovery.

SETUPH2

SETUPH2.BAT is similar to SETUPH.BAT except that it is used on systems that boot from the second physical hard disk. The syntax is

```
SETUPH2 A:
```

Drive A: must contain a diskette formatted with `FORMAT A: /S` that will be used for Check or Recovery.

When any of these batch files is run, it will make a path for the drive that contains the Check diskette. So the use of a drive letter before the command is not necessary after executing the first batch file. With FASTRUN, a path will be set to the files on the hard disk. ■

they are going to modify, though many programs also update directory, index, parameter, temporary, or backup files that may not be explicitly mentioned in the documentation. These files are usually recognizable by their file extensions; for example, .BAK for backup files, and so forth.

Any change to a .COM, .EXE, .BIN, .OBJ, .OVL, .LIB, .BAT, or .SYS file should be examined very carefully: these are the files (in addition to the boot or partition sectors) that a virus would attack. Even if a hardware or software glitch (rather than a virus) causes the changes to these files, you probably still would not want to

run them. You should note, however, that during installation or a change of options, many programs will legitimately modify the executable program itself (the .COM or .EXE file) rather than a parameter file. So, if you have run an INSTALL or CHANGE OPTIONS program, don't be unduly alarmed if you see an executable file listed as modified.

Be especially vigilant when it comes to DOS-related files, however. If any of these are changed, you've got a potentially serious problem. It's a good bet you've got some type of system corruption and perhaps even a virus. Another serious symptom is if CFCOMPC shows that a file has

changed, yet the DOS file date and time have not changed. This is important because it indicates that something has bypassed DOS to update the file. The cause could be a system glitch that caused a stray write to that file or someone "playing" with a sector editor such as Norton's NU. But it could also indicate the presence of hostile software.

Whenever you run CHKDSK, you should also keep an eye on the number of bytes in bad sectors. This should not spontaneously increase. Viruses frequently hide their code in bad sectors so they can modify a program without increasing its size.

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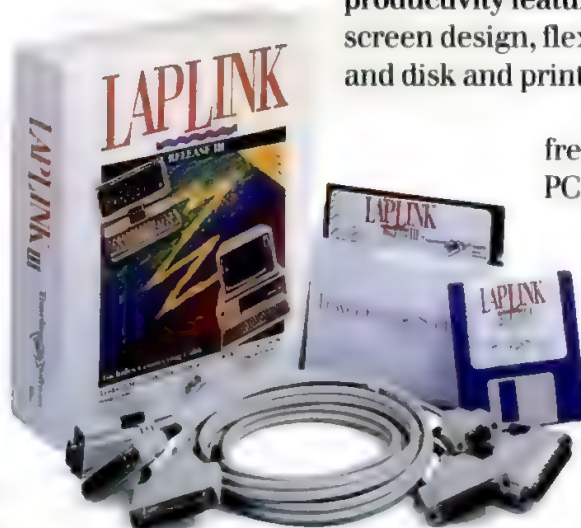
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To download the PCDATA Toolkit, its instructions, and its assembly listings, log on to PC MagNet. Enter GO UTILITIES or choose PC MAGAZINE UTILITIES from the top menu, then DIRECT UTILITY DOWNLOAD from the next menu. Enter the filename, then select the file you want

PCDATA BY MODEM

to download from those presented. Answer yes (Y) to DO YOU WISH TO DOWNLOAD? Press Enter to see the transfer protocols. Choose a protocol and download the file.

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Like all good software, the programs presented in *PC Magazine* get upgraded and improved. The only way to obtain the modified versions is to download them from PC MagNet. Here is a partial list of the programs that have been upgraded:

ANSI.COM, Version 1.3
BEN51.EXE (Benchmarks 5.1)
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.2 (works

with volumes greater than 32 MB).
DIRMATCH.COM, Version 1.1
EMS40.SYS, Version 1.1, (fixes a problem with *Lotus 1-2-3*).
LITES.COM, Version 1.1
LOG.COM, Version 1.1
PCMANAGE.EXE, Version 1.1
RN.COM, Version 2.0 (now works under DOS 4.x).
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
ZCOPY.COM, Version 1.2

For a complete list of all the programs in the Utilities Database, download UDCAT.ARC.

A downloadable index to *PC Magazine's* product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine Reviews Index* for issues from January 1988 to December 1989. This easy-to-use database is a subset of the *Computer Library Periodicals Database*, which is available on CD-ROM and on PC MagNet. It requires the search files in PCSRCH.EXE.

PCSRCH.EXE is a self-extracting archive containing the software used to retrieve citations from the *PC Magazine Reviews Index*. Please read the information file PCM.INF before you download the index.

CHECKING INDIVIDUAL DIRECTORIES

SCANDIR.BAT examines changes in the current directory. Run at intervals, it reduces the size of the report produced by SCANMAX or SCANSYS.

When adding a new directory, run SCANDIR to update the check data on your Check diskette quickly. Rather than writing the results of the comparison to))SYS.LOG, SCANDIR displays changes on the screen and pauses for acknowledgment. To check the current directory (drive C:) without FASTRUN, boot from the Check diskette in drive A: and enter

A:SCANDIR A:

Alternately, you could execute

FASTRUN A:

SCANDIR A:

Unlike SCANMAX and SCANSYS,

SCANDIR does not delete the directory created by FASTRUN, so SCANDIR can be repeated more than once without repeating FASTRUN.

CHECKING INDIVIDUAL FILES

CHECK.BAT can be used to check individual files or groups of files. For example, if you just changed several batch files, the command

CHECK *.BAT A:

will tell you which ones have been altered. Again, drive A: must be holding your Check or Check-mt diskette. Unlike SCANMAX, SCANSYS, and SCANDIR, CHECK will not update the information recorded on the Check diskette.

THE ROAD TO RECOVERY

Once the Data Integrity Toolkit has detected what looks like corruption, what should

you do about it? Here is a detailed method for recovering from data corruption, whether caused by a virus, a program bug, or something else. Once again, to simplify the description, the commands presented will assume that you are trying to recover drive C: and that the floppy drive you are using is A:.

First, write down whatever indication(s) of corruption you have. Record any events leading up to the failure. What programs did you run? What memory-resident (TSR) programs were loaded? Did these programs complete successfully? Were there any strange error messages or any unusual behavior by any program? Note these things now, while they are fresh on your mind.

Next, to be absolutely certain that there is no corrupted code resident in memory, power down your PC and boot it up from the Recovery diskette. For now, all programs you execute should come from this

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[illegible]

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Utilities

diskette. Unless you are sure you are *not* dealing with a virus, don't execute anything from any disk that has been used on the affected PC. You should be looking at the A: prompt.

If there is damage to the partition sector, execute

```
LODBOOT /P
```

to restore the original partition sector. Use /2 rather than /P if you boot from the second physical drive.

If there is damage to the DOS boot sector, change to the drive (in this case, C:) with the bad boot sector (your Recovery disk is still in drive A:) and enter

```
RELODB A:
```

RELODB will copy @@BOOT.SCT to the drive containing the corrupted boot sector and immediately execute LODBOOT /B to reload the boot sector.

If you haven't run a full SCANMAX, run it now. This will give you a full report of what has been corrupted, and if SCANMAX runs without any disk errors, the disk is probably not very sick. If there is any indication of a continuing hardware problem, that must be resolved first. Run whatever diagnostics you have on your Diagnose diskette and fix any hardware problems before proceeding any further. There's no point in reloading the files onto a disk that will shortly fail again.

If you encounter an unreadable file, it may be worth trying one of the utility programs such as Norton's DT. After apparently recovering the file, run CHECK against that file to verify that it is intact. I have never been able to successfully recover a file with a bad sector using any of the available utility programs, so you must be sure to verify the file's integrity.

Up to this point we have eliminated all system-wide problem sources. The report in))SYS.LOG should make it clear which files are corrupted. Thus, we're now ready to reload these files from a backup disk. After doing so, it's worthwhile to run CHKFILE against the just-restored files. The check information from these files can be compared with that recorded in))SYS.LOG. If your))A.LOG files were also backed up, you can simply run a SCANDIR to determine whether the files were

successfully restored.

Now that you've recovered your files and reestablished system integrity, try to determine what initially caused the corruption. If your best guess is a hardware glitch, run some diagnostic programs for a good long time. The reason for this is that many hardware problems are intermittent. It may take a while to shake them out again or it may take a special circumstance, such as a cold or a hot computer. Are all boards and connectors seated firmly?

If your best guess is a software glitch, keep a close eye on the programs that were run prior to the appearance of the problem.

**PCDATA's))SYS.LOG
creates a report
of the files that
have been corrupted.**

Run SCANSYS frequently before and after running the suspect programs.

If there is any chance that the corruption may have been caused by malicious software, then try to re-create the problem. Check with other users to see if they have encountered the same difficulty. Compare the check values calculated by CHKFILE for the suspect programs with those that other users have for the same programs. It is possible that you have a corrupted version of an otherwise innocent program.

CUSTOMIZING PCDATA

The batch files that drive the toolkit programs can easily be customized to meet your specific needs. Many users may find that adding the /O parameter to CFCOMPC in SCANRFDR.BAT is desirable. By adding this parameter, you will not be notified of a change if the file is the same but only the DOS time and date stamps have changed. If you have programs that rewrite files without changing them, this will eliminate unnecessary messages.

If you can spare 80K and put your toolkit programs on your RAMdisk, this will speed their execution. Just run FASTRUN.BAT and let it copy everything. If you can't afford quite so much RAM, modify SCANRFDR.BAT so that file))B.LOG is written to and deleted from the

RAMdisk. Then modify FASTRUN.BAT to copy at least SCANRFDR.BAT, CHKFILEC.COM, MIRDIR.COM, and CFCOMPC.COM to the RAMdisk. This requires only 24K. Then modify the statement

```
PATH=\\))PCITK.TMP
```

to include your RAMdisk. For example, you would use

```
PATH=E:\\;\\))PCITK.TMP
```

if your RAMdisk is drive E:.

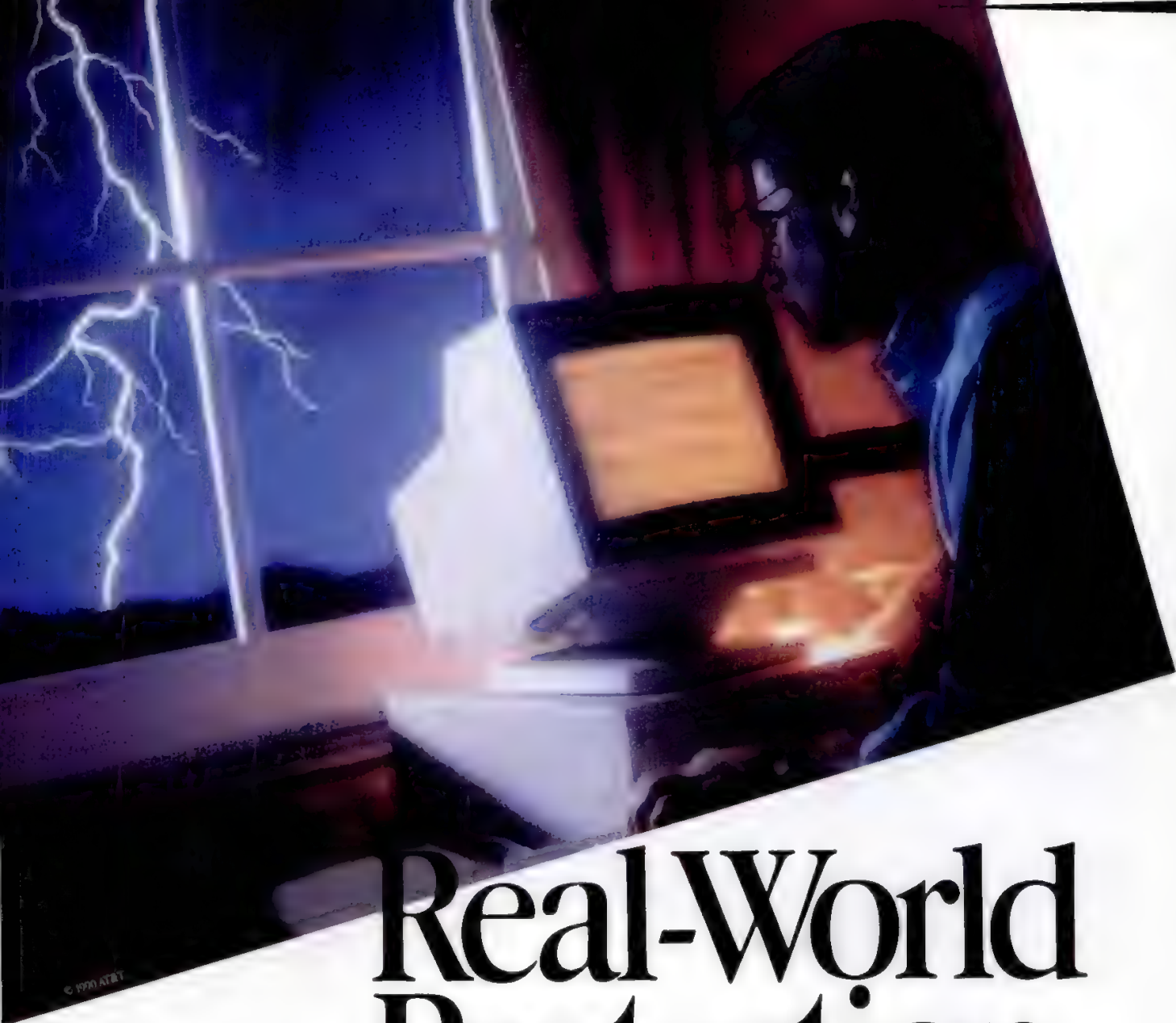
The Data Integrity Toolkit will detect all viruses, even those that might be written to circumvent it. If you are willing to trade protection for convenience, you may wish to use the "D" batch files: CHECKD.BAT, SCANSYSD.BAT, and SCANDIRD.BAT. These batch files put the report (.LOG) files into each directory on the disk or drive being checked rather than in a separate directory on a floppy. This increases the convenience of running the Toolkit, but exposes you to the threat that someone might write a virus that infects a program and then locates and modifies the associated .LOG file. In such a case, the change to the file would not be detected.

In order to use the "D" batch files, SCANRFDR.BAT, SCANDIR.BAT, SCANSYS.BAT, CHKFILEC.COM, CFCOMPC.COM, XALL.COM, and MIRDIR.COM must be in a directory that's on your path. These files could also be placed on a RAMdisk, as just described.

It's a very good idea to change the names used for the report files. By default, they're called))A.LOG. The name can be anything, but it must *begin* with two characters that are not used this way anywhere else on your system. If you change the)) prefix, you must also change the /I:)) parameter for CHKFILEC in SCANRFDR.BAT so that it will ignore files beginning with the two new characters. You may also want to include the /1 and/or the /2 parameter on CHKFILEC. This will cause your version of the toolkit to use a different algorithm than the standard. This makes it a little more difficult for a person or a program to corrupt your system in a way that can't be detected.

DESIGN AND PROGRAMMING ISSUES

The *PC Magazine* Data Integrity Toolkit was developed with two goals in mind.



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Utilities

First, it had to be able to detect any type of system corruption, even that caused by a sophisticated virus. Second, it had to be practical to run on even the slowest PCs.

Toward the first goal, it was vital to make sure that if a toolkit report file should become corrupted, the toolkit would not mistakenly report changes in unchanged files. For this reason, all files generated by the toolkit carry internal self-check information. Any damage to these files will be detected whenever they are processed. An exception to this is CHKFILE's output. Since this is formatted for display, it has only partial self-checking capability. That is one of the reasons the toolkit utilizes CHKFILEC rather than CHKFILE as its file-checking engine.

The second goal translates into two important characteristics: speed and size. The programs must be fast and small, and they should run quickly on even the least powerful systems.

The algorithms chosen to generate the check data were selected because they execute quickly on 80x86 processors. Parameters that determine how the programs work, such as /1 and /2 for CHKFILE and CHKFILEC, directly modify the executable code. This programming technique is ordinarily frowned upon, but it is appropriate here, since the affected code is in the most frequently executed loop of the program. By modifying the instructions directly, we eliminate the need to check a flag constantly, and still we provide maximum flexibility to the user.

The CFCOMP and CFCOMPC programs utilize this technique with their /O parameter. This parameter allows the user to see only files that have really changed, not files that are identical except for different DOS time and date stamps.

Both speed and small size become an important factor in designing the memory management necessary for CFCOMP and CFCOMPC. Both programs must read and compare two report files. Each of the programs tries to allocate a 128K buffer for these files. This maximizes speed, but what if the PC does not have this much memory? In this case, the programs will reissue the memory allocation request for the maximum amount of memory available and will use that. This provides maximum flexibility and speed, while still running on small systems.

The toolkit programs have been optimized for fast execution on the slower PCs, but they really fly on 80286 and 80386 PCs. Where possible, word-oriented instructions were utilized (for example, MOVSW rather than MOVSB) in order to optimize performance on machines that have a real 16-bit data path. On a standard IBM PS/2 Model 50Z with a 32MB hard disk (using 30MB in 915 files), SCANMAX ran in 7 minutes 15 seconds.

The programs put their initialization code in the file buffer area. This is the code that interprets the parameters you enter for each program, performs any required program customization, and (optionally) opens the files. Again, this technique is somewhat nonstandard, but the memory it saves is significant. In CHKFILEC, for example, the initialization code is twice as large as the rest of the program.

All Data Integrity Toolkit programs return DOS ERRORLEVEL codes so that they can be driven effectively by batch files. If they execute normally, they return a zero ERRORLEVEL. The higher the ERRORLEVEL returned by the program, the more severe the condition that occurred. Invalid syntax will always return the highest ERRORLEVEL and will produce a display of the correct syntax. Most serious errors, such as input/output errors, will also cause the program to beep and prompt the user to hit a key. This prevents any serious errors from being overlooked when the programs are driven by batch files.

A DAUNTING PROCESS?

At first glance the processes I've described here may seem rather involved. Don't be discouraged, though. Most of the steps outlined above center around setting up the system and initializing the toolkit files that provide the information necessary to maintain a stable system. Once over this hurdle, the process simply becomes one of running SCANMAX at regular intervals.

In the best of all possible worlds, SCANMAX would always report that nothing is amiss. But should a glitch or some foreign agent cause your system suddenly to spin out of balance, you will know it and be able to take immediate action. In the real world, that's how to survive. ■

Wolfgang Stiller is the systems programming administrator for the Florida Department of Labor and an independent developer of PC software. He specializes in computer security.

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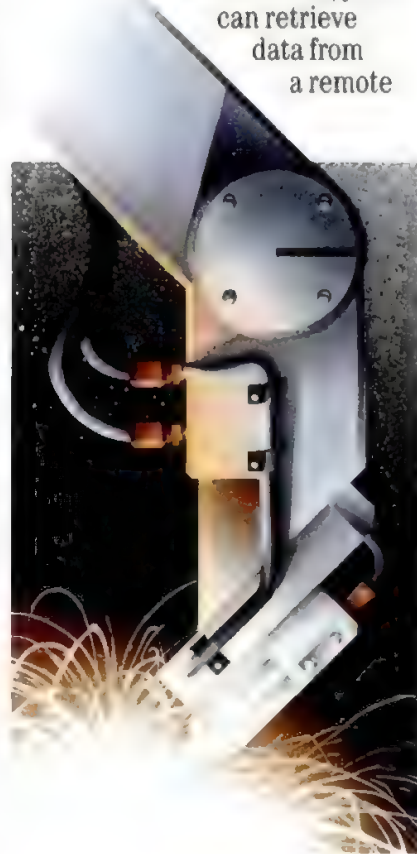
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LAN TIMES
**READERS
CHOICE**
1989

by
Charles Petzold

Environments

Printing Under the OS/2 Presentation Manager, Part 1

Remember the "paperless office"? That was one of the promised benefits of the "computer revolution." The reality, of course, is that our computers generate more paper output than even any of us could possibly have imagined. In fact, many computer applications—such as word processing, desktop publishing, business graphics, and computer-assisted drawing programs—exist primarily to prepare printed documents.

Someday the paperless office may still become a reality, but until then we cannot lose sight of the importance of hard copy. Printer graphics may not be as much fun to play with as the more immediate and interactive graphics on a video display, but graphics programming has to be useful as well as fun. Like it or not, there's no way we can avoid the subject of printing under the OS/2 Presentation Manager.

■ Device independence means that OS/2 must handle not only the video display, but also the printer. Here's an overview and a guide to the setup process.

THE LOVE/HATE RELATIONSHIP

Printers are the peripherals we love to hate. They're awkward, cranky, obstinate, and often ugly pieces of hardware. I've just received *PC Magazine's* sixth annual printer review issue, and I know the Herculean labors that go into it each year. As editor-in-chief Bill Machrone once observed, we undertake the printer survey not because it's easy to evaluate and review printers, but because it's so difficult.

Programming for printers is never an easy job, either—not under DOS and not under the Presentation Manager. PM certainly simplifies some aspects of printing, but it introduces unique complications of its own. Even Presentation Manager users don't get off the hook. If you've explored the various dialog boxes involved in setting up a printer, you know how confusing printer configuration can be.

I'll be discussing printing under the Presentation Manager both from a user's and from a programmer's perspective in my next several columns. After some preliminaries, I'll present a PM program that does some rudimentary printing—a simple

wall calendar, one month to a page. But, like those who prepare *PC Magazine's* annual roundup of new printers, I approach the subject of printing under the Presentation Manager not with pleasurable anticipation, but from a stoical sense of duty.

HIGHER EXPECTATIONS

Printing has become a more complex problem in recent years because we have come to have higher expectations for the computer-printed page. In the early 1980s, simple daisy wheel and dot matrix printers were the rule. Programs could assume that the printer could fit 66 80-character lines on a page. Printer output consisted of ASCII characters and simple control codes, such as carriage returns, line feeds, and backspaces.

Printers became more sophisticated when they began to support variations such as underlining, italics, and multiple fonts. These features are selected by software through control sequences. Printer manufacturers expanded their features and control sequences without a great deal of concern about industry compatibility.

In some early DOS word processors (such as *WordStar*), printer control sequences for essential functions were patched right into the program. But soon, as both the number of features and the number of printers grew, software manufacturers responded by introducing the concept of the "printer driver."

Printer drivers isolate the nitty-gritty details about each printer's operations in a separate file that the program can use in a consistent manner. If a word processing program wishes to print underlined text, it consults the printer driver for the control sequence necessary for underlining.

Although formatted text remains the most important requirement for word processing programs, these days we have also come to expect that word processors will integrate text and graphical images. This obviously adds complexity to the printer driver.

Today's word processors for DOS (and even those written for the non-Presentation Manager mode of OS/2, such as *WordPerfect* and *Microsoft Word*) are often shipped with a couple of diskettes full of nothing but printer drivers. Each software manufacturer designs his own printer drivers; *WordPerfect* printer drivers are nothing like *Microsoft Word* printer drivers, though both ultimately send the same control codes.

THE PM DIFFERENCE

The OS/2 Presentation Manager is different because support for graphics output devices has been moved from the application

Environments

to the operating system. PM includes a device-independent graphics programming language called the Graphics Programming Interface (GPI).

From a programmer's perspective, GPI consists of about 230 function calls that all begin with the prefix `Gpi`. GPI is called a "device-independent" interface because programs use the same function calls to display text and graphics on any output device, be it a video display or a printer. (I'll continue to use the word "printer" here to refer to all hard-copy devices, including pen plotters, digital cameras, and typesetting equipment.)

The application program doesn't even need to know which device it's using. Drawing a circle on a VGA monitor requires the same code as drawing a circle on a Hewlett-Packard LaserJet. The operating system takes over the burden of translating the GPI function calls into displayable images.

Of course, there must be some software within OS/2 that translates GPI function calls into whatever specific control codes the output device understands. It's a driver, of course. OS/2 thus includes both video display drivers and printer drivers. IBM officially terms each of them a "presentation driver."

THE PRESENTATION DRIVER

A presentation driver is a dynamic link library. If you have OS/2 1.1 or later installed on your hard disk, you'll find a file in the `C:\OS2\DLL` directory named `DISPLAY.DLL`. This is the presentation driver for the video display.

IBM's OS/2 installation diskettes contain presentation drivers for several IBM video display adapters: `IBMCGA.DLL` for the CGA, `IBMEGA.DLL` for the EGA, `IBMVGA.DLL` for the VGA, and `IBMBGA.DLL` for the 8514/A adapter. During the OS/2 installation process, one of these files is copied to the `C:\OS2\DLL` directory and renamed `DISPLAY.DLL`.

It is probable that manufacturers of high-resolution video adapters will themselves soon begin supplying PM presentation drivers with their boards. If you install one of these boards in your machine, you will need only to replace your existing `DISPLAY.DLL` with the presentation driver for the new board. All your existing PM programs will then automatically use

the capabilities of the board.

Replacing `DISPLAY.DLL` is not *quite* as easy as it sounds, however. When OS/2 is booted from the hard disk, `DISPLAY.DLL` is in use and protected against deletion. One way to replace it is by booting the original installation diskette, pressing Esc to drop to a command line, copying the new presentation driver to the hard disk, and then rebooting.

The presentation driver for the video display is always named `DISPLAY.DLL`. Presentation drivers for printers are a little different. The filename identifies the printer, and the extension is `.DRV` rather than

**The initial release
of IBM OS/2 1.2
supports more than
80 printers
and plotters.**

`.DLL`. For example, `PSCRIPT.DRV` is the presentation driver for PostScript printers and `IBM5152.DRV` is the presentation driver for the IBM 5152 Graphics Printer.

The initial release of IBM OS/2 1.2 (September 1989) contains 16 printer presentation drivers. More than 80 different printers and plotters are supported. They include all IBM dot matrix and laser printers, all IBM and Hewlett-Packard pen plotters, 17 Epson printers (plus four "generic" printers that use Epson control sequences), and 33 PostScript printers and typesetters (plus a generic PostScript device).

Of course, there are many printers *not* yet blessed with a Presentation Manager driver, and this is a continuing complaint of OS/2 users. The big omission is support for the popular Hewlett-Packard LaserJet series. Fortunately, a LaserJet driver is due to be released by the time you read this column.

A FATAL FLAW?

OS/2 presentation drivers are quite sophisticated. As I mentioned earlier, the presentation driver is responsible for translating GPI function calls into text and graphics, whether displayed on the video display or on the printer.

The designers of the Presentation Manager took an extreme approach to these drivers. *Every* GPI function that directly draws something or affects drawing has a corresponding entry point in the presentation driver. (The only exceptions are those GPI functions that address "segments." Segments are coded collections of drawing commands that are stored in memory.)

This allows a presentation driver for an intelligent output device to make full use of it. For example, in my November 14, 1989, Environments column I discussed the `GpiPolySpline` function, which draws a Bézier spline. The entry point for this function is located in the `PMGPI.DLL` dynamic link library. The presentation driver also has an entry point for the same function. If the output device can draw a Bézier spline itself (as PostScript printers can, for example), then the presentation driver need only translate that call into something understood by the device. Otherwise, the presentation driver can make use of functions in `PMGRE.DLL` (the graphics engine) to assist in rendering the graphic on the device.

Thus, a Presentation Manager program is communicating almost directly with the presentation driver, which is working directly with the device. This architecture accounts for the comparatively fast graphics performance of the Presentation Manager and gives the driver great leeway in using the device. It anticipates the day when a high level of graphics coprocessing will be built into graphics output devices.

However, this overall design also places a great burden on the presentation driver, and this worries me. Not only are the drivers responsible for drawing, they are also responsible for returning information to application programs. This information describes the device—its resolution and color capabilities, for example. If the drivers are not written to handle these requests in a consistent manner, there could be some compatibility problems between certain application programs and certain drivers.

Can this really happen? Yes, it can—and has. The presentation driver for pen plotters (`PLOTTERS.DRV`) distributed with OS/2 1.1 was so buggy as to be almost unusable. (It's been greatly improved in OS/2 1.2.) When the `GpiQueryRGBColor` function reports that an 8-pen plotter is capable of creating 16 unique colors, one's faith in the presentation driver is shaken more than a little. If `PLOTTERS.DRV`—a presentation driver re-

Environments

leased by IBM—was so bad, how can we have faith that presentation drivers developed by third-party printer manufacturers will be any better?

Obviously, presentation drivers must be extensively tested before they are unleashed on the world. IBM and Microsoft should come up with a comprehensive test suite that will ensure that drivers perform in a compatible manner according to the definition of the GPI functions. A device-independent graphics programming interface doesn't mean much if the drivers are buggy.

PRINTING AND SPOOLING

The OS/2 Presentation Manager includes a print spooler program. It's called the Spooler Queue Manager in OS/2 1.1 and the Print Manager in OS/2 1.2. I'll use the latter name here.

The OS/2 Print Manager captures printer output from all programs running under OS/2—even programs running in DOS compatibility mode. The printer output is saved to disk files. The program doing the printing is then free to do something else while the Print Manager shovels the printer output to the printer. Each print job is listed in the Print Manager window in an ordered queue. You can cancel jobs or reprioritize them.

The printer presentation driver and the spooler work together. This is particularly true when you are printing from a Presentation Manager program. The spooler can save the program's printer output to disk in two different formats. The first is a device-independent format (called the "standard" format) that must subsequently be translated by the printer driver before reaching the printer. The second is a "raw" format, one that already contains the device-dependent control sequences generated by the printer driver.

You obviously need to install the correct printer driver if you want to print graphics from a Presentation Manager program. More than this, you need the correct printer driver to do *any* printing from OS/2. Even when you print from a non-Presentation Manager program, it is the printer driver that initializes the printer before the document is printed and ejects the page when finished. The printer driver has to generate the needed control sequences for the printer.



Figure 1: The Spooler dialog box invoked by the Control Panel.

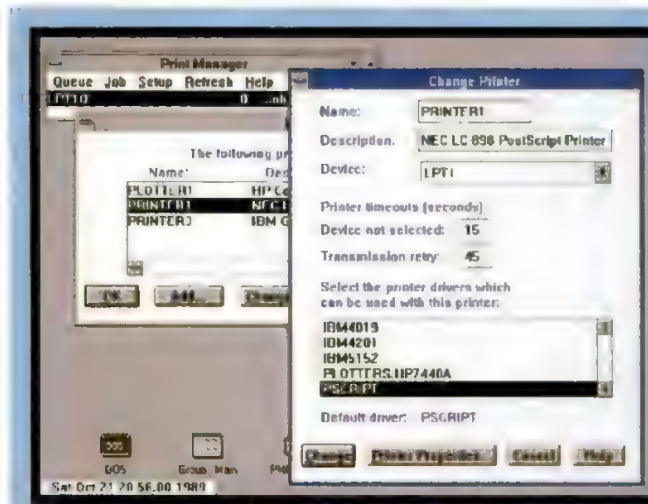


Figure 2: The Change Printer dialog box allows you to change the configuration associated with a printer name.

IBM supplies a driver called IBM-NULL.DRV that you can use if you don't yet have a driver for your printer. Alternatively, either you can indicate that the printer port is not connected to a printer (I'll discuss this shortly) or you can disable the spooler entirely. This will cause printer output to bypass the spooler and printer driver.

DRIVER INSTALLATION

You install a new printer driver on your hard disk by selecting the Add Printer Driver option from the Installation menu of the Control Panel. By default, the dialog box lists all the printer drivers on drive A:. (You can choose another drive or directory if you wish.) You then pick the ones you want.

Unfortunately, in many cases you need to know the specific model number of your printer. For example, if you have an IBM Graphics Printer, you need to know that

the model number is 5152. The driver is named IBM5152.DRV and is listed simply as IBM5152.

When you install a driver from the diskette containing PLOTTERS.DRV, you'll find that all the plotters supported by this driver are listed separately:

PLOTTERS.IBM6180
PLOTTERS.IBM6182

and so forth. The driver supports 22 different IBM and Hewlett-Packard plotters. The Epson and PostScript drivers also support more than one printer, but these drivers are listed simply as EPSON and PSCRIPT. In these cases, you select the specific printer you own later, when configuring the printer in the Print Manager program.

As we'll see in the next issue, the method that PLOTTERS.DRV uses to support multiple plotters complicates the code that

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is needed to begin printing. None of the code samples released by IBM and Microsoft for OS/2 1.1 showed how to open the necessary "device context" for one of these plotters correctly. Not even the OS/2 1.1 File Manager could correctly print a file to a plotter! This has been fixed in OS/2 1.2.

The Control Panel will normally copy the driver files to the C:\OS2\DLL directory. But if you're installing a printer driver that is already on your hard disk, it needn't be copied to C:\OS2\DLL. The Control Panel can add some information to OS2SYS.INI (OS2.INI in OS/2 1.1) so that the system can find the installed drivers the next time you reboot.

PRINTER CONFIGURATION

Once the printer driver is installed, you must configure it. This is the nasty part. In OS/2 1.1 you do it through the Setup menu in the Control Panel. In OS/2 1.2, the configuration function has been moved to the Print Manager. I'll describe the OS/2 1.2 approach; it's similar to that of 1.1 and has been improved somewhat.

One reason for the complexity is that you can have several printers attached to your system, both through the parallel printer ports (such as LPT1) and the serial ports (such as COM1). You might even have multiple printers attached to a single port through a cable switch box. (You can also have printers available through a network, but I won't get into network issues here.) Besides being able to select among them, you want to be able to specify which of these printers will be the default—that is, the printer that will normally be used by Presentation Manager programs when they print.

Moreover, all of this information should be available to a Presentation Manager application in a manner that is transparent to the user. When you configure your printers through the Print Manager, the information is stored in OS2.INI (in OS/2 1.1) and OS2SYS.INI (in OS/2 1.2) so that applications can access it. We'll see how this works in the next issue.

The Presentation Manager uses the concept of a "printer name" to help you identify your various printers. You choose a descriptive name for each printer, which can be up to 32 characters long and can contain any character except a period,

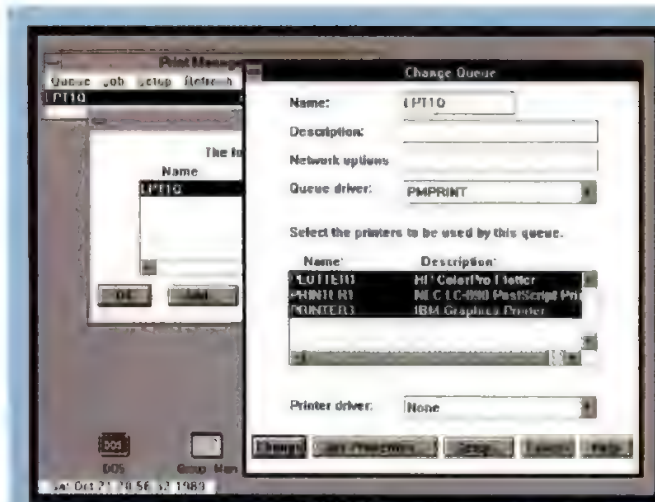


Figure 3: This dialog box lets you associate all your printer names with a single queue name.

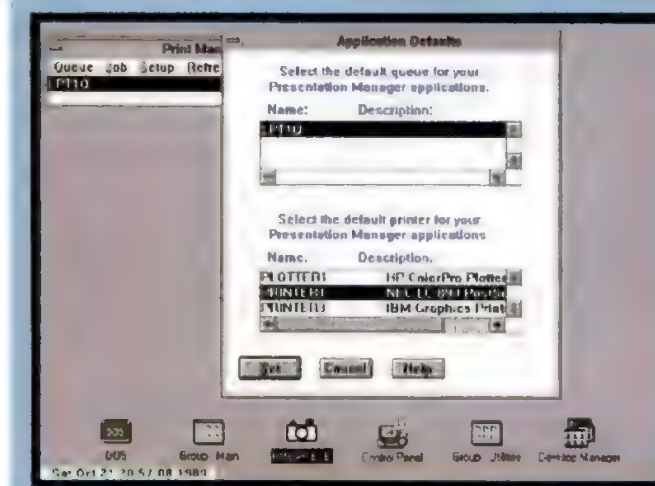


Figure 4: The Application Defaults dialog box allows you to select which printer name becomes the default.

comma, semicolon, or equals sign. Although the printer name can theoretically contain spaces, I've seen at least one beta version of a PM program that chokes on a printer name with spaces. By default, the Presentation Manager assigns the name PRINTER1 to your first printer.

It would be nice if I could say simply that each printer you have on your system is identified by a printer name. But that's not true. If you happen to have multiple printers connected to a single port through a cable switch box, one printer name identifies them all.

It's correct to say instead that each printer name is associated with one unique parallel or serial port. Basically, a printer name is just a more user-friendly way of saying LPT1, COM2, or whatever. You'll define one printer name for each parallel or serial port to which a printer is attached. Two different printer names cannot be associated with the same port.

Each printer name can be associated with one or more printer drivers, of which one is the default. Unless you have a cable switch box or you routinely swap printer cables, however, you'll generally associate only one printer driver with the printer name.

THE CONFIGURATION DIALOGS

With this background, let's now explore the various dialog boxes invoked by the four options on the Setup menu in the Print Manager program. These four options are Spooler, Printers, Queues, and Application Defaults.

The Spooler item invokes a small dialog box that lets you disable or enable the spooler and set a directory path for spooler files, as shown in Figure 1. Enough said.

The Printers item displays a dialog box that lists all the printer names, with optional text descriptions. From this dialog box, you can add a new printer name, delete an

Environments

existing printer name, or change information associated with a printer name. The Add and Change options invoke nearly identical dialog boxes.

Figure 2 shows the Change Printer dialog box that is invoked by selecting Printers on the Setup menu. The field for the printer name is at the top, followed by the optional description field and the device field. The device field indicates the parallel or serial port. When you click on the little arrow at the right of the field, you get a list of all available ports.

One of the port options is "None." You might want to select this option if you want output from non-PM programs to bypass the spooler. If you print from a non-PM program to LPT1 and there is no print-

**The Print Manager
program in OS/2 1.2
lets you manipulate
printer information
with menu options and
dialog boxes.**

er name associated with LPT1, then the printer output will go directly to the port. If you do this, however, you won't be able to print from a PM program.

The list box near the bottom of the dialog box shows all the printer drivers that you've installed from the Control Panel. You can select multiple drivers for a single printer name. The selected drivers are highlighted. The last one you select is the default and is indicated below the list box. To change the default printer associated with a printer name, you may have to click twice on the name.

Warning: At least one recent Presentation Manager program I've seen has a problem with multiple drivers for one printer name. This will probably be fixed eventually, but for now you may want to avoid possible difficulties and select just one driver.

The Printer Properties button at the bot-

tom of the dialog box invokes yet another dialog box, but this one is actually under the control of the printer driver. (Yes, Presentation Manager printer drivers can display dialog boxes!) What you can do in this dialog box depends on the printer. At the very least, it will allow you to specify the paper size and select portrait or landscape mode. As I indicated earlier, the Epson and PostScript drivers also allow you to select the specific printer you have.

The third option on the Print Manager's Setup menu is Queues. Each queue has a queue name. As with printer names, you can choose your own queue names. By default, the OS/2 installation program uses the queue name of LPT1Q.

Each queue name is associated with a single queue processor. A queue processor is a dynamic link library file used by the Print Manager to assist in spooling printer output. OS/2 1.2 is shipped with only one

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queue processor, a file that is named PMPRINT.QPR.

Each printer name can be associated with one or more queue names, of which one is the default. The queue name really indicates the queue processor that the Print Manager will use to spool the printer output. Print jobs are listed in the Print Manager window under the queue name.

Confusing? You bet! But here's the secret: You need only one queue, even if you want to print on two different printers at the same time. So do yourself a favor and don't mess around with this queue stuff.

All you need to do is this: Whenever you install a new printer name, select the Queues option from the menu and select Change from the dialog box. You'll get

One Print Manager menu option lets you set the applications' default printer.

another dialog box, which is shown in Figure 3. The list box toward the bottom lists all the printer names. Make sure they're *all* highlighted. Then press the Change button, and back out of the dialog boxes by pressing Esc.

The fourth and final item in the Print Manager's Setup menu is Application Defaults. This displays the dialog box shown in Figure 4. From the second list box, select the printer that you want application programs to use as a default. If you're configuring a printer or plotter for a serial port, there's one more step: go back to the Control Panel to set up the baud rate and other communications parameters. That's it!

COMING UP

Now that we've seen how the user configures a printer, in the next issue we'll examine how this information is stored in the OS2SYS.INI file. I will show you how a Presentation Manager program can retrieve the information and use it for the most essential step in printing: opening a "device context" for the printer. ■

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Arithmetic Routines for Your Computer Programs, Part 6

My last two columns discussed the general characteristics of the Intel 80x87 numeric coprocessors and the various data formats and operations they support. It's now time to focus in on some practical programming details: use of the floating-point registers, basic arithmetic operations, and synchronization of the CPU and coprocessor.

Throughout, I'll use "CPU" to denote any of the Intel 80x86 processors: 8086, 8088, 80286, 80386, or 80486. The term "coprocessor" will refer to any member of the coprocessor family—8087, 80287, or 80387—or to the 80387 logic embedded in the 80486. I won't refer to specific CPU or coprocessor models unless a statement does not apply to its entire family.

WORKING WITH STACK MACHINES

One of the reasons that the Intel coprocessors have a reputation for being difficult to program is that they are true stack machines. The eight floating-point registers, named ST(0) through ST(7), are organized as a push-down stack and lie, in effect, in a separate address space. This is in sharp contrast to the CPU stack, which is located in normal memory. You can bypass the PUSH and POP instructions to address arbitrary CPU stack elements directly, but your access to the coprocessor's stack is much more restricted. Only the topmost cell of the stack—ST(0), sometimes abbreviated ST—is "visible" to load and store operations.

The general approach to carrying out calculations on a stack machine is familiar to FORTH programmers and to anyone who owns a Hewlett-Packard calculator. First you load values onto the stack, then you execute an operation that removes its arguments from the stack and pushes a result onto the stack. The result can then be left on the stack and used as an argument for the next operation, or it can be unloaded from the stack into a variable.

Stack machines are very efficient in chained calculations because most parameter passing occurs within what amounts to a relatively fast local memory. Stack ma-

■ Programming the Intel coprocessor family involves using postfix syntax and requires paying attention to CPU synchronization.

chine code is also quite compact because the location of arguments and results for most instructions is implicit. Bulky offsets and complex address calculations are required only when the coprocessor makes its infrequent references to external RAM. Stack machines are well suited to multitasking environments because stack machine code is naturally reentrant; there are usually only a few special-purpose registers that must be saved across a context switch.

But stack machines also have unique disadvantages. Keeping mental track of the location of more than two or three items on the stack at any one time is difficult even for experienced programmers. Stack machine programming also demands using a *reverse Polish* or *postfix* style that software developers accustomed to the *infix* syntax of more-traditional languages find painful to write, read, and debug. Finally, a particular problem of stack machines is that the stacks are usually comparatively shallow. For a stack machine to be fast, the stacks must be implemented on the processor chip, and stack memory (like the general registers of a conventional CPU) requires a lot of tran-

sistors and silicon real estate. Consequently, in designing your code you must be very careful to avoid stack overflows. You should keep in mind that any kind of reasonable recovery from an overflow is very difficult.

COPROCESSOR DATA MOVEMENT

As shown in the table in Figure 1, the coprocessor has a variety of load and store instructions that are used to move data from RAM to the floating-point register stack and back again. The assembler chooses the proper opcode based on both the mnemonic and the "type" of the operand. There is no direct communication between the CPU registers and the coprocessor registers. (I'll discuss the one minor exception to this rule later.)

First, let's look at transferring numbers from RAM to the coprocessor. (For the moment, I'll ignore synchronization issues, to which I'll turn later.) The following code loads a 32-bit floating-point number from a variable onto the coprocessor floating-point stack:

```
myvar    dd      ?  
          .  
          .  
          fld     myvar
```

Figure 2 (top) shows the use of the floating-point stack before and after this code executes. When indirect addressing is used, you must use the PTR operator to supply the assembler with the type information it needs. For example, to load the first two elements from an array of 32-bit

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COPROCESSOR DATA-TRANSFER COMMANDS

Data type	Load	Store
16-bit integer	FILD WORD PTR	FIST WORD PTR FISTP WORD PTR
32-bit integer	FILD DWORD PTR	FIST DWORD PTR FISTP DWORD PTR
64-bit integer	FILD QWORD PTR	FISTP DWORD PTR
32-bit floating-point	FLD DWORD PTR	FST DWORD PTR FSTP DWORD PTR
64-bit floating-point	FLD QWORD PTR	FST QWORD PTR FSTP QWORD PTR
80-bit floating-point	FLD TBYTE PTR	FSTP TBYTE PTR
80-bit binary-coded-decimal (BCD)	FBLD	FBSTP

Figure 1: These coprocessor instructions are used to transfer data from RAM onto the floating-point register stack or vice versa. Instruction mnemonics ending with "P" pop the coprocessor stack after storing the number on top of the stack into memory. Note that there are three "missing" instruction forms: the operand for FST cannot be an extended (80-bit) floating-point number, the operand for FIST cannot be a quad (64-bit) integer, and there is no BCD store instruction that does not pop the coprocessor stack.

floating-point numbers, you might write

```
myvar dd 4 dup (0)
.
.
mov bx,offset myvar
fld dword ptr [bx]
fld dword ptr [bx+4]
```

You use exactly the same technique to load 64-bit or 80-bit floating-point numbers onto the coprocessor, except that you declare the variables with the DQ or DT directives or else use QWORD PTR or TBYTE PTR in the operand.

Integer values are loaded from memory onto the coprocessor with the FILD instruction; FBLD is used with binary-coded-decimal (BCD) values. For example, to load a 32-bit integer from a memory variable, you could write

```
myvar dd ?
.
.
fld myvar
```

Remember, even though the value is stored in memory as an integer, it is converted to an 80-bit floating-point number

when it is loaded into the coprocessor.

Assume the value you want to transfer is in CPU registers DX:AX. You must transfer the number to memory before you can get it to the coprocessor. Make sure to store the less significant word of the value at the lower address:

```
myvar dd ?
.
.
mov word ptr myvar,ax
mov word ptr
myvar+2,dx
fld myvar
```

So as not to waste memory in your data segment on a statically allocated variable, take a page from C's book and create a temporary variable on the CPU's stack for the data, then transfer the value from the CPU stack to the coprocessor:

```
mov bp,sp
sub sp,4
mov [bp-4],ax
mov [bp-2],dx
fld dword ptr [bp-4]
```

If you prefer, you can accomplish the same

job a bit more quickly with the following:

```
push dx
push ax
mov bp,sp
fld dword ptr [bp]
```

The 80386 lets you write much more elegant code for such temporary variables, because (unlike the 8086 and 80286) it supports indexed addressing via the ESP register. For example, to transfer a 32-bit integer value from register EAX to the coprocessor, you could write

```
push eax
fld dword ptr [esp]
```

You ordinarily use the FSTP instruction to unload the result of a coprocessor operation into memory as a floating-point number. For example, to store the number on the top of the coprocessor stack into a variable as a 64-bit floating-point number, you would write

```
myvar dq ?
.
.
fstp myvar
```

The FSTP instruction "pops" the coprocessor stack when it transfers the value from the top of the stack to memory; the number that was previously the second number on the coprocessor stack ("next-on-stack") becomes the new top-of-stack, as shown in Figure 2 (bottom). FISTP and FBSTP store numbers into memory as integer and BCD data, respectively, and then pop the stack. Just as with the various load instructions, if the size of the data is not made explicit by reference to a typed variable, you must supply this information with a PTR modifier on the operand—or risk the consequences.

```
myvar dq ?
.
.
mov bx,offset myvar
fstp qword ptr [bx]
```

When you want to unload a number into memory *without* popping the coprocessor stack, you can use the FST and FIST instructions. These instructions are appropriate when you want to save an intermediate result from a calculation while still leaving a copy of the number on the coprocessor stack for use in subsequent

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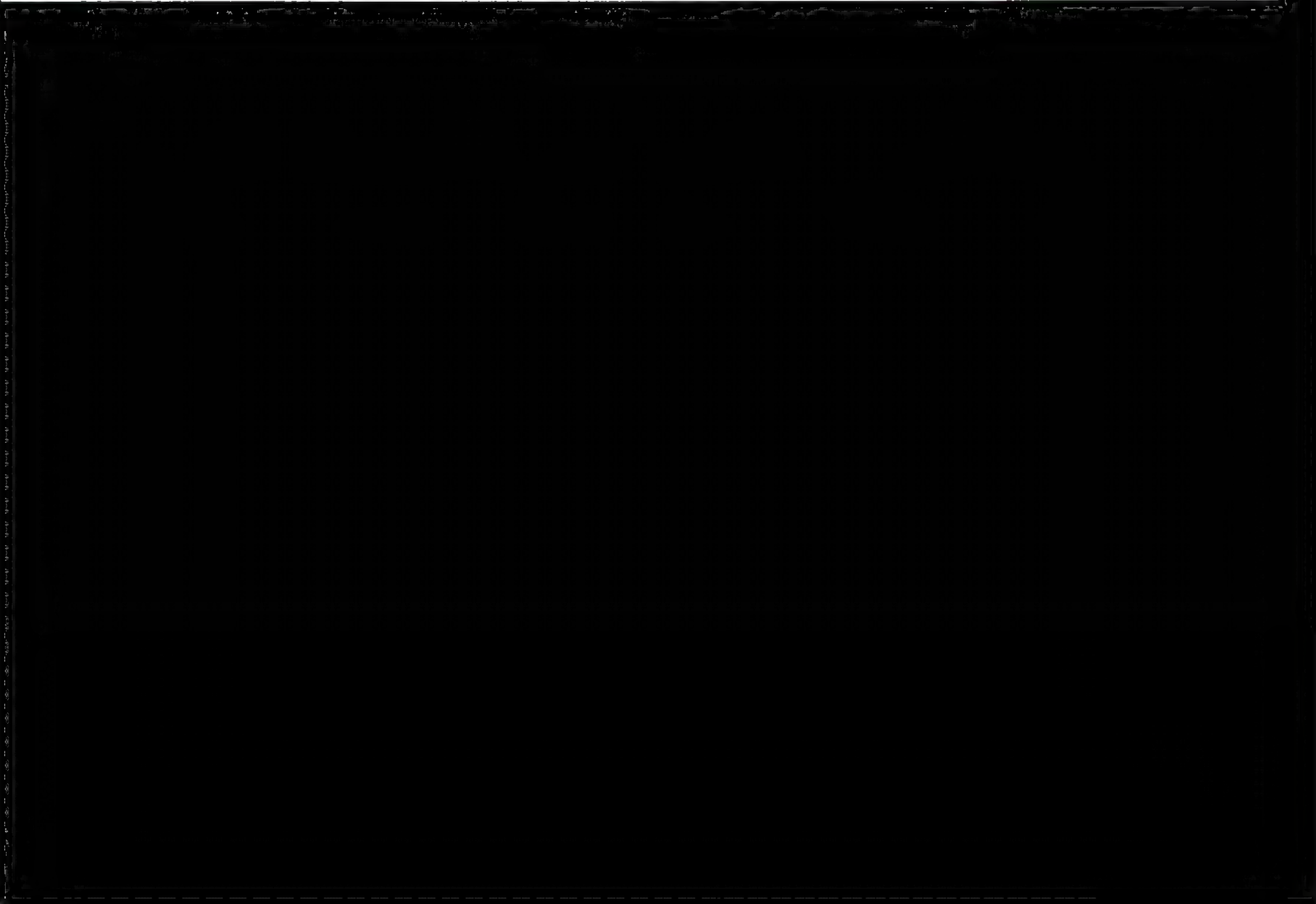
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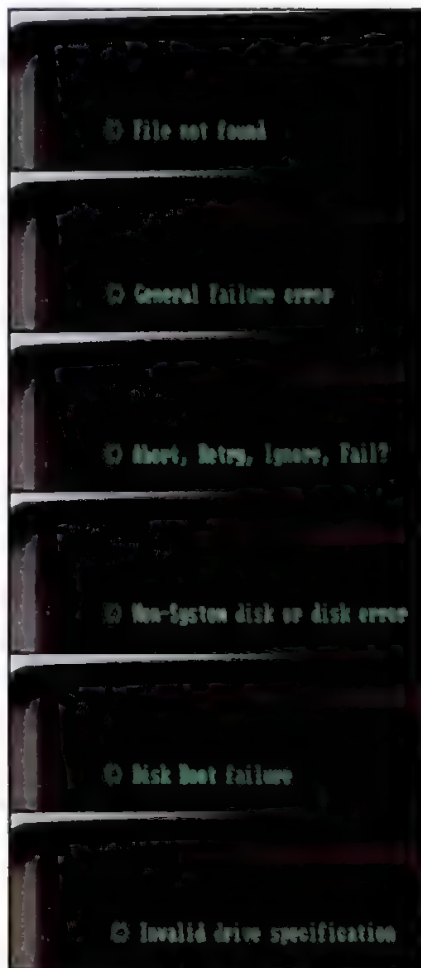
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floating-point operations. Interestingly, there are three "holes" in the coprocessor instruction set in this particular area: there is no BCD store instruction that does not pop the stack, FST cannot be used to store an 80-bit floating-point number, and, finally, FIST cannot be used to store a 64-bit integer.

In addition to transferring numbers between RAM and the coprocessor stack, the FLD, FST, and FSTP instructions can also be used to move numbers around within the coprocessor stack itself. This is an area in which we can borrow many useful programming concepts from FORTH. Twenty years of FORTH evolution have demonstrated, for instance, that five primitive stack operations—DUP, DROP, SWAP, OVER, and ROT—account for nearly all of the nonarithmetic stack manipulations that you'd see in a typical program. All five operations can easily be expressed in terms of the coprocessor's load, store, and exchange (FXCH) instructions, as illustrated in Figure 3.

TO WAIT OR NOT TO WAIT

One of the subtler aspects of coprocessor programming is the enforcement of proper synchronization between the CPU and the coprocessor. The CPU and the coprocessor share a single instruction stream (which is under the control of and fetched from memory by the CPU), but they can execute asynchronously much of the time. The CPU can complete several or even dozens of its instructions in the time required for the coprocessor to complete a floating-point operation.

Asynchronous execution is a powerful tool, but there are occasions when the programmer must bring both the CPU and the coprocessor to a known state before permitting further instructions to execute on one or the other. The primary software means of synchronizing the CPU and coprocessor is provided by the FWAIT instruction. The operation of this instruction is simple. If an FWAIT is encountered in the instruction stream and the coprocessor is busy, the CPU goes into a wait state until the coprocessor has finished its current operation.

On the original 8087 chip, the synchronization problem is very general: *all* synchronization is obtained by properly positioned FWAIT instructions. Not even a

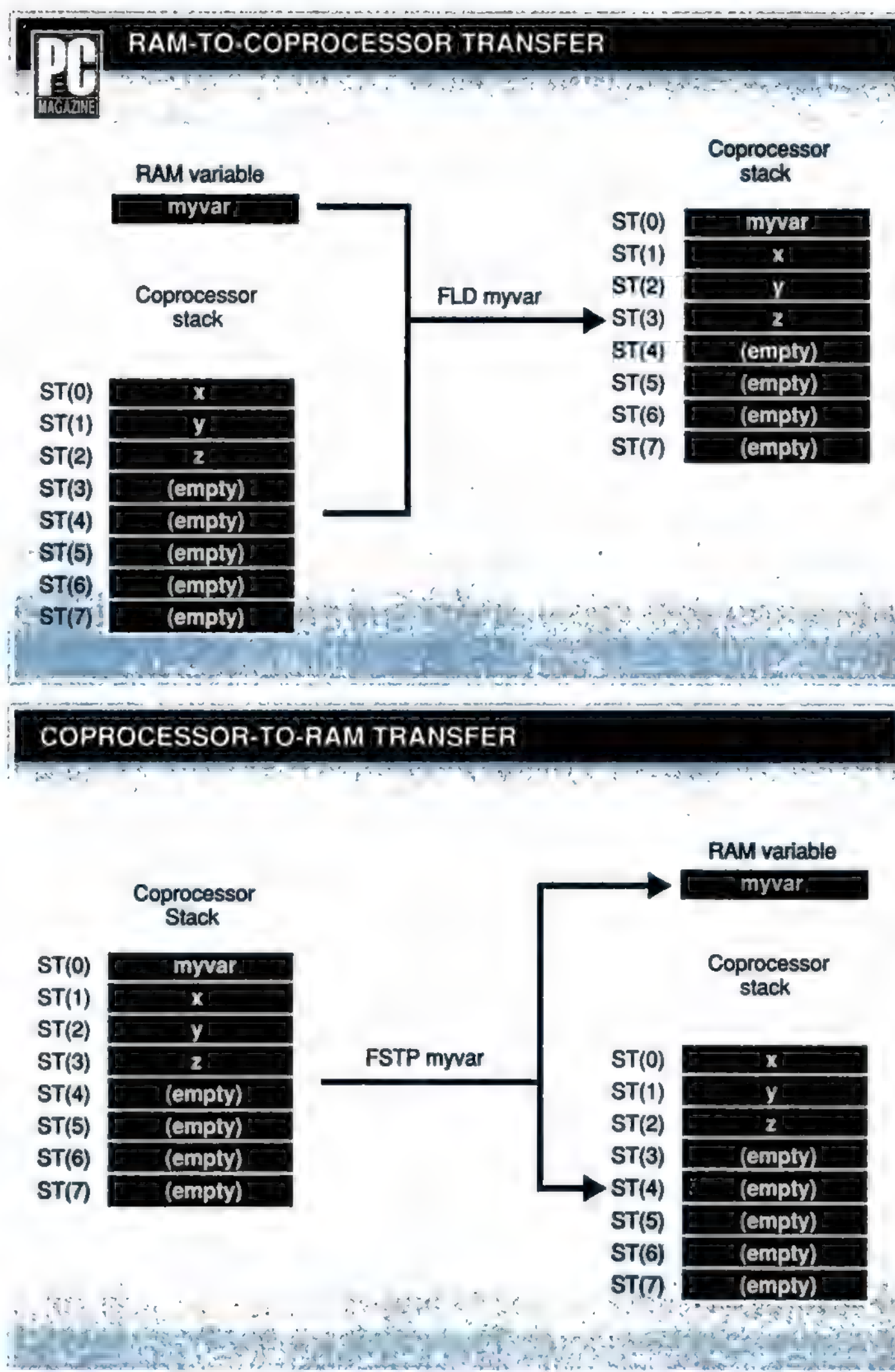


Figure 2: The coprocessor stack before and after an FLD instruction (top), and then before and after an FSTP instruction (bottom).

minimal degree of automatic synchronization is built into the hardware. If a floating-point instruction is encountered in the instruction stream before the coprocessor has finished its previous operation, the coprocessor simply becomes confused and returns erroneous results or hangs. The only safe approach to 8087 programming, therefore, is to put an FWAIT before every floating-point instruction.

To make the proper placement of

FWAITs for 8087 chips less of a chore for the programmer, Intel decided to have the "normal" forms of the 8087 mnemonics generate FWAIT prefixes automatically. For example, if you look at the machine code generated by the source code

```
fld    dword ptr [bp]
fld    dword ptr [bp+4]
```

you will find that what have actually been

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produced are the opcodes for

```
fwait
fld    dword ptr [bp]
fwait
fld    dword ptr [bp+4]
```

If you don't want the assembler to put an automatic FWAIT opcode before a floating-point instruction, you have to use the FN form of the mnemonic, such as FNLD (the N stands for "no-wait").

On the 80287 and 80387 chips, the hardware is somewhat smarter. It will automatically stall a floating-point instruction if the coprocessor is still busy, without requiring an explicit FWAIT. Thus, if you know that your program will be executing only on an 80287 or 80387, you can use the FN forms and obtain considerably more-compact code. You might think that the assembler would automatically disable the generation of FWAITS for the normal directives when a .287 or .387 directive is in effect, but unfortunately the assembler is not *that* logical!

There are also some situations in which you must program FWAITS explicitly, regardless of which coprocessor you are using. In general, you have to supply FWAITS when you are transferring data between RAM and the coprocessor, to ensure that the CPU will not access the memory locations until it is "safe." Consider the following code, which loads a 32-bit real number onto the coprocessor stack from a variable, then sets the value of the variable to 0:

```
myvar    dd    0
        .
        .
        fld    myvar
        fwait
        mov     word ptr myvar,0
        mov     word ptr
        myvar+2,0
```

If the FWAIT did not follow the FLD (thus delaying the CPU until the FLD was completed), the CPU might store zeros into the variable before the coprocessor had finished loading the variable. The value that arrived at the coprocessor would then be partially or completely incorrect.

In a real program, obviously, you'll try to defer the FWAIT and the CPU's modifi-



NONARITHMETIC STACK OPERATIONS

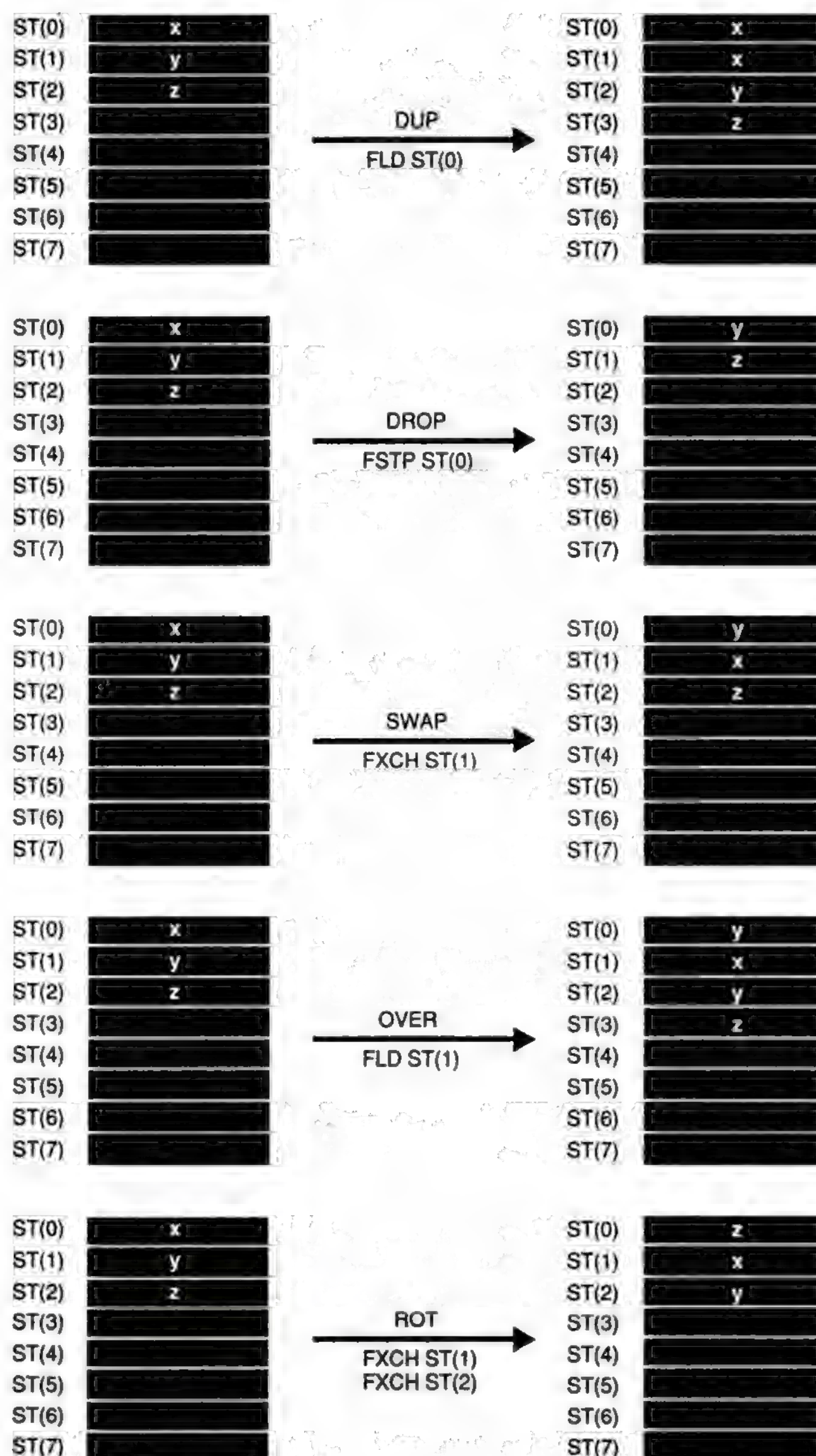


Figure 3: DUP, DROP, SWAP, OVER, and ROT are fundamental nonarithmetic stack operations.

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cation of the variable as long as possible, sandwiching other instructions in between, to minimize the chance that the FWAIT will stall the CPU for a significant number of cycles. You can omit the explicit FWAIT altogether if you can arrange your code so that another floating-point instruction is executed after the FLD but before the CPU again writes to the variable.

Similarly, when you unload a number from the coprocessor stack into RAM, you must make sure that the number has completely arrived before you try to access it with the CPU. The following code stores the number on top of the coprocessor stack into a variable as a 32-bit integer and then loads that integer into DX:AX:

```
myvar    dd    0
.
.
fstp     myvar
fwait
mov      ax,word ptr
myvar
mov      dx,word ptr
myvar+2
```

In this case, if the FWAIT did not precede the CPU's reference to the variable, the program might end up with a bogus value in DX:AX.

The lack of an explicit FWAIT in the proper place can lead to very subtle bugs. The following code transfers a 64-bit floating-point number from the CPU's stack to the coprocessor's stack:

```
mov      bx,sp
fld      qword ptr ss:[bx]
add      sp,8
```

This code does fail sporadically because at unpredictable intervals a timer (or other) interrupt will occur immediately after the execution of the ADD instruction but before the coprocessor has finished fetching the 64-bit number from RAM. Service of the interrupt causes the CPU's flag register, CS, and IP to be pushed onto the stack, overwriting the three most significant words of the floating-point number. This particular bug is fixed easily—once it is found—by putting an FWAIT before the ADD, but it's preferable to program defensively so that this nasty kind of problem cannot occur.



COPROCESSOR ARITHMETIC INSTRUCTIONS

Arithmetic operation	ST(0) with ST(n), or floating-point value in memory	ST(0) with ST(n), then pop ST(0)	ST(0) with integer value in memory
Add	FADD	FADDP	FIADD
Subtract	FSUB	FSUBP	FISUB
Subtract reversed	FSUBR	FSUBRP	FISUBR
Multiply	FMUL	FMULP	FIMUL
Divide	FDIV	FDIVP	FIDIV
Divide reversed	FDIVR	FDIVRP	FIDIVR

Figure 4: The source and/or the destination operand may be implicit in the code. The result of an operation always replaces the destination operand.

BASIC ARITHMETIC OPERATIONS

The coprocessor instructions for the four basic arithmetic operations—addition, subtraction, multiplication, and division—fall into three basic categories, as shown in Figure 4. Although all these machine instructions have two operands—a source and a destination—one or both of the operands may be implicit in the machine code or source code or both. The result will always replace the destination operand.

The instructions in the first column of Figure 4 work on two floating-point numbers. The source operand may be either a floating-point register or a floating-point number in a memory variable. The destination operand is always in a floating-point register. One of the operands must be ST(0); in most cases, it is convenient to make ST(0) the destination.

The instructions in the second column appearing in Figure 4 also work on two floating-point numbers, but they “pop the stack” after the operation is completed. If the two operands are in ST(0) and ST(1), these instructions allow you to discard the source operand and keep only the result in the destination operand, thereby implementing “classic” stack machine behavior.

The instructions in the third column of Figure 4 always have ST(0) as the implicit destination operand and an integer value in a memory variable as an explicit source operand. The result is left in ST(0) and the value in the memory variable is unchanged.

A few simple, practical examples will make these basic arithmetic instructions a bit more clear. The following code adds the floating-point numbers in the variables

“myvar1” and “myvar2” and leaves the sum in “myvar3”:

```
myvar1    dd    ?
myvar2    dd    ?
myvar3    dd    ?
.
.
fld      var1
fld      var2
faddp     st(1),st(0)
fstp      var3
fwait
```

Interestingly, it happens that if you write a non-stack-popping arithmetic instruction without any operands, the assembler assumes you want classic stack behavior and generates the “pop” form anyway. In other words, if you write

```
fadd
the assembler generates
faddp     st(1),st(0)
```

Equivalent but somewhat faster code would be

```
myvar1    dd    ?
myvar2    dd    ?
myvar3    dd    ?
.
.
fld      var1
fadd      var2
fstp      var3
fwait
```

Looking at Figure 4, you may be puzzled by the categories that are labeled

Power Programming

“subtract reversed” and “divide reversed.” To see why these exist, let’s first consider the “normal” subtract and divide instructions. FSUB subtracts the source operand from the destination operand and leaves the result in the destination operand. FDIV divides the destination operand by the source operand and leaves the quotient in the destination operand. In other words, both of these behave exactly as you would expect them to from your experience with the Intel CPUs’ subtract and divide instructions.

The “reversed” instructions are provided to allow you to skip a load or exchange instruction prior to a subtract or divide in case the wrong value of a pair happens to be in the desired destination. For example,

```
faubrp    st(1),st(0)
```

is exactly equivalent to

```
fxch      st(1)
fsubp     st(1),st(0)
```

The importance of the reversed instructions is even more evident when one of the operands is in memory. For example:

```
myvar     dd      ?
.
.
.
fdivr     myvar
```

has the same effect as

```
myvar     dd      ?
.
.
.
fld       myvar
fxch      st(1)
fdivp     st(1),st(0)
```

Three more simple coprocessor instructions that should be mentioned along with the basic arithmetic operations are

```
fchs      change sign
fabs      absolute value
fsqrt     square root
```

All three of these instructions are written without any operands; they always take their argument from ST(0) and return their result to ST(0).

TESTING AND COMPARING NUMBERS

The ability of the whole coprocessor family to compare and test floating-point numbers rests on seven instructions: FCOM, FCOMP, FCOMPP, FICOM, FICOMP, FTST, and FXAM. The 80387 offers three additional comparison instructions: FUCOM, FUCOMP, and FUCOMPP.

Let’s dispose of the three most important comparison instructions first: FCOM, FCOMP, and FCOMPP. All three compare the source operand with ST(0) and set the condition code bits in the coprocessor status word according to the result of the comparison. FCOMP pops one value off the stack after the comparison, while FCOMPP pops two. Obviously, FCOMPP is intended for use in “classical” stack programming, where the top two values on the stack are compared destructively.

Once the condition code bits are set, you can use FSTSW to store the coprocessor status word someplace where the CPU can inspect it. On the 8087 you must unload the status word to memory and then load it into a CPU register:

```
status    dw      ?
.
.
.
fstsw     status
fwait
mov       ax,status
```

On the 80287 and 80387, by contrast, you can transfer the status word directly to the AX register:

```
fstsw     ax
```

(This is the sole instance of direct register-to-register communication between the coprocessor and CPU, which I mentioned earlier.)

Once the status word has been retrieved, you might be tempted to use the CPU’s AND or TEST instruction to evaluate the state of the condition code bits. However, Intel has thoughtfully provided a much faster—albeit obscure—method. The condition code bits in the coprocessor status word are positioned so that they can be shoved into the CPU’s zero flag, parity flag, and carry flag with the SAHF (Store AH into Flags) instruction. Once the CPU flags have been forced in this way, they can be used to control conditional jumps in the usual manner.

For example, the 80287/80387 code that follows compares the value in ST(0)

with the number in ST(1), discards both, and then branches according to the result:

```
fcompp
fstsw    ax
sahf
ja       label1 ;if st(0) > st(1)
jmp      label2 ;if st(0) <= st(1)
```

With this technique, you must use only the conditional jump instructions JA, JAE, JB, JBE, JE, JNE, and their aliases. Using conditional jumps that also rely on the overflow flag (such as JG or JL) can lead to some very strange results.

FCOM, FCOMP, and FCOMPP all generate an exception if one or both of the numbers being compared is Not a Number (NaN). This means an earlier operation had an invalid operand or generated an invalid result and that the exception was not masked by the program. If it was masked, the instructions return a special condition

**The coprocessor tests
floating-point numbers
with seven key
instructions . . .**

code indicating an “unordered” result.

FUCOM, FUCOMP, and FUCOMPP were added in the 80387 to allow more exception-handling flexibility. They never generate an exception regardless of the value of their operands, yet they can still return an “unordered” result.

Finally, FTST and FXAM evaluate the number in ST(0) nondestructively and set the condition code bits according to the result. FTST compares ST(0) with 0; it is used to determine whether a number is negative, 0, or positive. FXAM examines ST(0) to determine whether it contains a valid normalized floating-point number, 0, negative or positive infinity, a denormalized number, NaN, and so on.

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CIRCLE 263 ON READER SERVICE CARD

by
Craig Stinson

Spreadsheets

DYNAMIC GRAPH TITLES

Lotus 1-2-3 does not directly allow you to mix static text with dynamic numbers in its graph titles. However, you can surmount this limitation, as a simple example will illustrate. The graph shown in Figure 1 reflects a worksheet with the monthly sales volume of apples, oranges, and pears. The axis titles reference cells that take advantage of the @STRING function to mix labels and formulas. The x-axis title references a cell, MAX, which contains the formula

```
+ "THE MAX SALES WERE "  
@LEFT(I16,7) & " AT "  
@STRING(H16,0)
```

and the y-axis references a cell named AVG, which contains the formula

```
+ "THE AVG SALES WERE "  
@STRING(H17,0)
```

In the formulas above, H16 and H17 refer to cells in the worksheet that use @MAX and @AVG to get the maximum and average sales numbers; I16 refers to a cell that uses a look-up function to get the name of the best-selling product (apples, oranges, or pears). Consequently, when the numbers in the data range are changed, the results of the formulas change and the values in the titles automatically follow.

John Dillman
San Antonio, Texas



For graph titles, 1-2-3 lets you assign either hard-coded text or a cell reference, but not both at once. To make a title have both fixed text and a changeable number, you need to reference a cell containing a string formula. The string formula concatenates the static and dynamic components of the title.

If the dynamic component is a number, you have to convert it to a string with @STRING. Attempting to concatenate a text string directly with a number will not win the approval of 1-2-3. However, when the dynamic component is text—as in the

■ **DYNAMIC GRAPH TITLES:** Use @STRING to mix text and formulas in 1-2-3 graph titles.

■ **1-2-3 IN THE SERVICE OF SCIENCE:** An ingenious but simple trick for generating graphs with error bars.

■ **KEEP REPORT DATES ACCURATE:** Here's a formula that automatically readjusts the ending date of a given period.

case of the word APPLES in Mr. Dillman's x-axis title—no string function is normally required. The @LEFT function in the first formula is, in fact, unnecessary.

One final point to note: when referencing a cell in a graph title, it's always best to reference it by name, as Mr. Dillman has done here. That way, if you use /Move to rearrange your worksheet, 1-2-3 will keep its pointers current. While this problem

arises in Release 2.01 and Release 2.2, it has been resolved in Release 3.

1-2-3 IN THE SERVICE OF SCIENCE

I use Lotus 1-2-3 to analyze laboratory data; however, it's not ideal for scientific graphing. For example, it doesn't include any obvious way to generate graphs with error bars. I discovered a trick, though, that makes 1-2-3 draw error bars on top of data points.

Consider the data in Figure 2. The first two columns show theoretical distance versus time for an object accelerating at a uniform rate. The third column lists the range of experimental error for each data point. The fourth and fifth columns list the experimental maxima and minima for each data point. For example, at 3 seconds the theoretical position is 9 centimeters and experimental results fall within the range of 9 ± 7 .

To plot this data with error bars, I transposed the Time column to a row, then copied it into two adjacent rows. I did the same for the Distance column. Then I transposed the Max column to a single row below Distance and the Min column to a single row below Max. The resulting layout is shown in Figure 3.

To produce the graph shown in Figure 4, I chose an XY type with three data ranges.

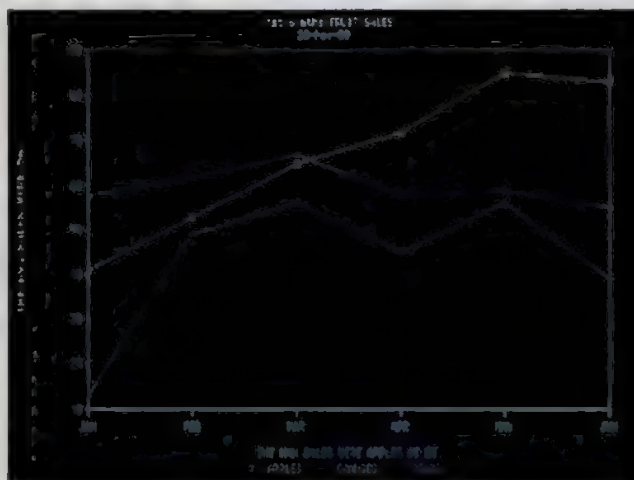


Figure 1: The contents of the axis titles are not entered directly through the menu option. Instead, each title references a worksheet cell that uses @STRING to mix static text with changeable values.

Spreadsheets

The X range, representing time, is A40..K42. The A range, representing distance, is A43..K45. The B range, representing the error bars, is A46..K48; it includes not only the Max and Min rows but an additional blank row. This is important: without the blank row, 1-2-3 joins the bottom of one error bar to the top of the next and creates zigzags instead of separate vertical lines.

Arneil P. Reyes
Riverside, California



This is a sterling example of how creative thinking can make a good piece of software do things it was never meant to do. There are three essential aspects to Mr. Reyes's trick. First, the values have to be transposed from columns to rows. Second, the maxima and minima values have to be treated as a single—rather than two separate—data series because they form the high and low points of the error bars. Third, the error-bar data series have to include one null point for each high-low pair.

To clarify things, let's look at the beginning of this graph point by point. The first three points in the X range (time) are 0, 0, and 0. The first three points in the A

GRAPHING ERROR BARS: SAMPLE DATA					
	A	B	C	D	E
1	Time	Dist.	Dist.		
2	(sec)	(cm)	Error	Max	Min
3					
4	0	0	5	5	5
5	1	1	6	7	-5
6	2	4	4	8	0
7	3	9	7	16	2
8	4	16	6	22	10
9	5	25	6	31	19
10	6	36	9	45	27
11	7	49	8	57	41
12	8	64	7	71	57
13	9	81	6	87	75
14	10	100	7	107	93

Figure 2: This miniature spreadsheet contains theoretical data for an object accelerating at a uniform rate.



GRAPHING ERROR BARS: TRANPOSED DATA

	A	B	C	D	E	F	G	H	I	J	K
40	0	1	2	3	4	5	6	7	8	9	10
41	0	1	2	3	4	5	6	7	8	9	10
42	0	1	3	3	4	5	6	7	8	9	10
43	0	1	4	9	16	25	36	49	64	81	100
44	0	1	4	9	16	25	36	49	64	81	100
45	0	1	4	9	16	25	36	49	64	81	100
46	5	7	8	16	22	31	45	57	71	87	107
47	-5	-5	0	2	10	19	27	41	57	75	93

Figure 3: To create graphs with error bars, the original data must be transposed, and the range that specifies an error must include an empty row. Following this procedure will prevent the graph from connecting the bars.

range (distance) are also 0, 0, and 0. So far, so good; 1-2-3 plots A against X by drawing a dot at the origin of the graph. The first three points in the B range (error) are 5, -5, and null. 1-2-3 plots B against X by drawing a line through the origin from +5 to -5.

The fourth, fifth, and sixth data points are 1, 1, and 1 for X and also 1, 1, and 1 for A. 1-2-3 draws a line from the graph's origin to the point (1,1). For B, the fourth, fifth, and sixth data points are 7, -5, and null. 1-2-3 draws a vertical line from 7 to -5. Note that because the third data point in this range was null, this vertical line is not connected to the vertical line through the origin.

The purpose of the blank row should now be clear. The null points keep 1-2-3 from joining the error bars. It is important to note that a row of zeros would not accomplish the same thing. 1-2-3 often treats blank cells as equivalent to cells holding the value 0, but, fortunately, it does not do so in this case.

Why the transposition of the original data? To answer this, you must remember that when a range includes more than one row and more than one column, 1-2-3 always works its way through that range in columnwise fashion. If you laid out each range in this example as three columns instead of three rows, the X range would be processed as 0, 1, 2, 3, 4, 5, and so on, instead of 0, 0, 0, 1, 1, 1, and so on. The tenth point in this layout would be 10 for X and 100 for A. The eleventh point would be 0 for X and 0 for A, so the graph would include a straight line back from the top of the curve to the origin—not what Mr. Reyes had in mind.

KEEP REPORT DATES ACCURATE

My staff and I use Lotus 1-2-3 to produce periodic reports that must be identified by the ending date of any given period. To

Designing 1-2-3

graphs that include error bars is a sterling example of how creative thinking can make a good piece of software do things it was never meant to do.

avoid errors in generating this date, I have developed a formula that will automatically assign the correct ending date to these reports. The formula is

```
(@INT((@NOW-@INT($BASE))/$PERIOD)*$PERIOD+$BASE)
```

The result of the formula is contingent upon the assigned values of two cells that I have named PERIOD and BASE. PERIOD specifies the number of days that the report covers—7 for a week, 91 for a 13-week quarter, and so on. BASE specifies the

Spreadsheets

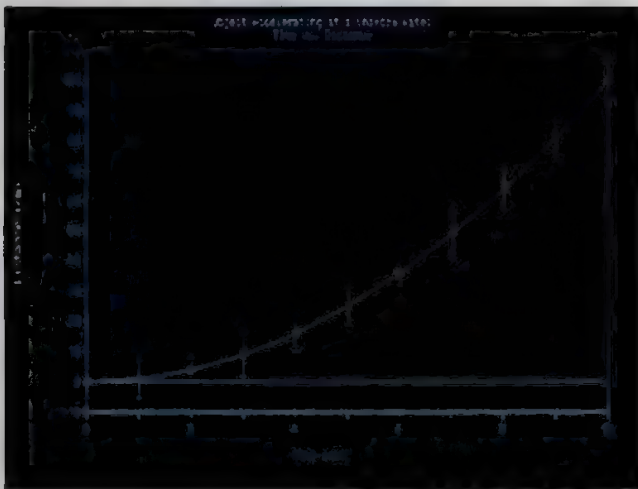


Figure 4: Graphing error bars turns on two important "tricks": transposing the original data, and including a blank row in the range of the error.

ending date of some earlier period; its value is expressed as an integer that is itself derived from the value returned by either the @DATE or @NOW function.

I will give an example from my own reports. The period is a week, so PERIOD has a value of 7. Saturday is considered the last day of the week, so BASE can be any previous Saturday; I keep BASE set to January 2, 1988.

A step-by-step tour of the formula will clarify things:

- @INT(\$BASE) removes any fractional component of \$BASE—just in case someone uses @NOW to generate the value.
- @NOW - @INT(\$BASE) yields the number of days that have elapsed since the base date.
- (@NOW - @INT(\$BASE)) / \$PERIOD returns the number of periods that have elapsed since the base date.
- (@INT((@NOW - @INT(\$BASE)) / \$PERIOD) removes the fractional component—and hence the extra days—from the previous expression.
- (@INT((@NOW - @INT(\$BASE)) / \$PERIOD) * \$PERIOD converts the number of periods into the total number of days that have elapsed between the base date and the end of the last complete period.
- (@INT((@NOW - @INT(\$BASE)) / \$PERIOD) * \$PERIOD + \$BASE adds the integral value of the base date to the number of days that have elapsed; the result is a serial date value. Format this value as days, months, and years, and you have the appropriate ending date for the report.

Kevin Keppler
Bellingham, Massachusetts



You might want to consider automating the selection of the BASE and PERIOD values to reduce the chance of a report appearing with the wrong date. For example, you could use a simple {MENCALL} macro to generate the two key values for each kind of periodic report. And with a macro, you could prevent anyone from using @NOW to determine BASE. Bullet-proofing BASE and PERIOD in this way lets you simplify the formula a little: you can remove the second @INT now that you won't have to worry about someone entering a nonintegral base value.

Speaking of simplification, you can jet-tison the outermost pair of parentheses in your formula without damaging the outcome. This move, combined with the elimination of one @INT function, produces

```
@INT((@NOW-$BASE)/$PERIOD)*$PERIOD+$BASE
```

which is a little easier on the eyes.

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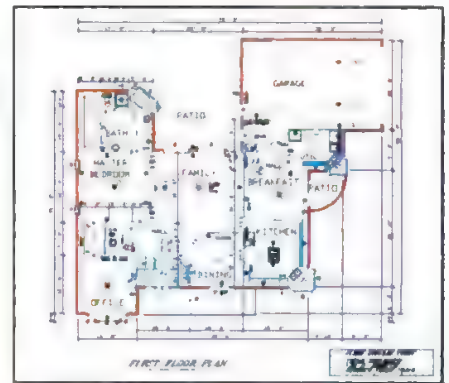
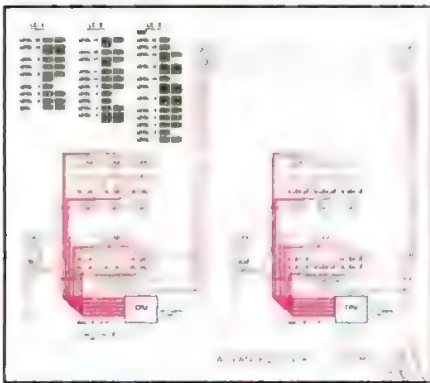
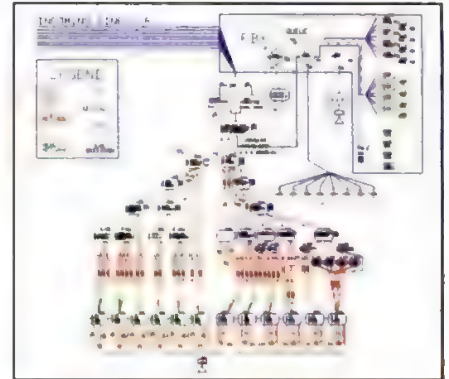
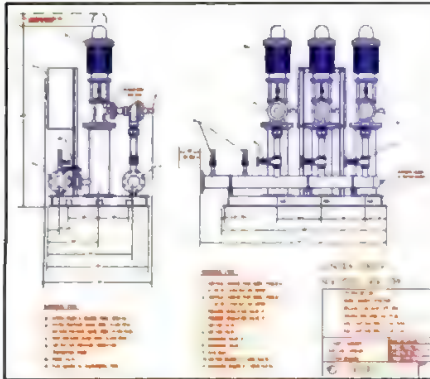
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CIRCLE 506 ON READER SERVICE CARD

by
Neil J. Rubenking

User-to-User

REPETITIVE LOOPING IN BATCH FILES

The DOS FOR statement allows repetitive looping inside batch files; for example,

```
FOR %%x IN (1 2 3 4 5 6 7) DO ECHO  
One iteration
```

However, the number of iterations must be set in advance and can't be modified during the batch process. Furthermore, it becomes increasingly cumbersome to use a FOR loop with more than ten or so iterations. (And the DOS command-line limit of 127 characters means that 50-odd iterations is the absolute limit—NJR.)

To overcome these restrictions, I created COUNTER.COM, which allows the number of iterations to be set when the batch file runs. Now you can specify the number of loop operations from the command line.

COUNTER reads the number of iterations from a file called N.TMP. It decrements this value and then it rewrites it to N.TMP. COUNTER then converts the number from its ASCII value to its numeric value by subtracting 48 (the ASCII code for 0), and exits with a return code equal to the numeric value. The batch file is now capable of controlling program flow by testing the ERRORLEVEL.

N.TMP is a temporary file, so COUNTER deletes it when the number of remaining iterations becomes zero. If COUNTER cannot open N.TMP, it simply

■ **REPETITIVE LOOPING IN BATCH FILES:** COUNTER.COM lets you repeat batch commands up to 255 times.

■ **SIMPLIFYING ERRORLEVEL TESTS:** Here's how to convert ERRORLEVEL to an environment variable.

■ **ANOTHER METHOD FOR DETECTING VIRUSES:** Use ordinary DOS programs to detect changes in your hard disk's boot sector.

exits with zero return code.

COUNTER reads only the first ASCII character in N.TMP and ignores all others. At first this might seem to limit the number of iterations to nine. However, values up to 256 can be obtained by using other ASCII characters. Suppose, for example, that the first character in N.TMP were X, or ASCII 88. COUNTER would subtract 48 and give you 40 iterations. If the first character has an ASCII value less than 48, add 256 to the negative result to find the number of iterations. \$ has an ASCII value of 36; subtracting 48 gives -12, and adding 256 yields 244 iterations.

DOORBELL.BAT (Figure 1) illustrates how to use COUNTER. Simply typing DOORBELL at the command line echoes a message that mimics one ring of a doorbell. Type DOORBELL 7, however, and you'll get seven "rings."

Jeffrey J. Hamilton
Jessup, Maryland



Figure 2 shows a DEBUG script that will create COUNTER.COM. Type the file carefully, using an editor that can produce ASCII text files

with no added control characters. Be sure to include the blank lines before and after the line

```
E 14B 'N.TMP' 0 0
```

and the blank line after the final Q. When you have finished that, use the following command

```
DEBUG < COUNTER.SCR
```

to produce COUNTER.COM.

Not every character is a potential input to DOORBELL.BAT. You just can't echo certain characters to a file. These include

COUNTER.SCR COMPLETE LISTING

```
N COUNTER.COM  
A 100  
MOV AX,3D02  
MOV DX,014B  
INT 21  
JNB 010E  
XOR AL,AL  
JMP 147  
MOV BX,AX  
MOV CX,1  
MOV DX,151  
MOV AH,3F  
INT 21  
DEC BYTE PTR [151]  
MOV AX,4200  
XOR CX,CX  
XOR DX,DX  
INT 21  
MOV AH,40  
MOV CX,1  
MOV DX,151  
INT 21  
MOV AH,3E  
INT 21  
MOV AL,[151]  
SUB AL,30  
CMP AL,00  
JNZ 147  
MOV AH,41  
MOV DX,14B  
INT 21  
XOR AL,AL  
MOV AH,4C  
INT 21  
  
E 14B 'N.TMP' 0 0  
  
RCX  
52  
W  
Q
```



DOORBELL.BAT COMPLETE LISTING

```
@ECHO OFF  
ECHO DOORBELL.BAT ~ Batch file to  
ECHO illustrate use of COUNTER.COM  
ECHO Usage: DOORBELL [number]  
IF "%1"=="" GOTO loop  
ECHO %1 > N.TMP  
:loop  
ECHO Ding dong!  
COUNTER  
IF ERRORLEVEL 1 GOTO loop
```



Figure 1: DOORBELL.BAT "rings" up to 255 times by using COUNTER.COM.

Figure 2: Redirect this script into DEBUG to create COUNTER.COM, a loop utility for batch files.

User-to-User

ASCII characters 3, 8, 9, 10, and 11. It's handy that N.TMP starts counting at ASCII 48, the 0 character. The five example characters correspond to 211, 216, 217, 218, and 219 repetitions. Surely, if you need *that* many repetitions, you can round off to 215 or 220!

To figure out what character corresponds to a given number of repetitions, just add 48 to the number. If the result is over 255, subtract 256 from it. You still don't know what *character* to enter, but it's easy to find. Press Alt, tap out the number you calculated on the numeric keypad, and release Alt. You'll see the character on your screen.

Each call to COUNTER takes a small but noticeable amount of time. COUNTER has to open N.TMP, read it, write the new value, and close it. A FOR loop has no such overhead, so if your batch file can get by with FOR, use it instead of COUNTER. I did write a set of batch lines that accomplish the same thing as COUNTER, using four environment variables and a *lot* of IF tests. The result took about 40 batch lines and was noticeably slower than using COUNTER. If you can write a *fast* loop counter for batch files that does *not* require an external program, I'd like to see it.

SIMPLIFYING ERRORLEVEL TESTS

Convert the ERRORLEVEL into the environment variable E, ranging from 000 to 255, by inserting the three lines in Figure 3 into a batch file. Try this!

Michael Bein
Chelsea, Quebec
Canada



This tip seems too good to be true. It converts the DOS ERRORLEVEL to an environment variable in just three batch lines! Once you've got the variable, you can use it in many

ERRVAR2.BAT

COMPLETE LISTING

```
ECHO OFF
SET E=
FOR %%q IN (0 1 2) DO IF ErrorLevel %%q00 SET E=%%q
IF "%E%"=="2" GOTO over200
FOR %%q IN (0 1 2 3 4 5 6 7 8 9) DO IF ErrorLevel %E%%q0 SET E=%E%%q
GOTO digit2
:over200
FOR %%q IN (0 1 2 3 4 5) DO IF ErrorLevel %E%%q0 SET E=%E%%q
:digit2
IF "%E%"=="25" GOTO over250
GOTO digit3
:over250
FOR %%q IN (0 1 2 3 4 5) DO IF Errorlevel %E%%q SET E=%E%%q
GOTO done
:digit3
FOR %%q IN (0 1 2 3 4 5 6 7 8 9) DO IF ErrorLevel %E%%q SET E=%E%%q
:done
```

Figure 4: This batch file will convert any ERRORLEVEL from 0 to 255 into an environment variable.

ways—perhaps jump to a label named for the variable, or use it as input to a program or another batch file. Actually, it *is* too good to be true, but a few more lines of batch code patch it up nicely, as we'll see below.

The IF ERRORLEVEL *n* test is *true* whenever the ERRORLEVEL is greater than or equal to *n*. ERRVAR.BAT uses this fact to gradually build the environment variable E to equal the ERRORLEVEL. The third line of the batch file tests the ERRORLEVEL against 000, 100, and 200. Say the ERRORLEVEL is 155. The first test would set E to 0 because the ERRORLEVEL is greater than 000. The second test sets E to 1 because 155 is greater than 100. But the third test doesn't change E. Variable E now has the value 1.

The next line refines the search by getting the second digit. This FOR loop checks the ERRORLEVEL against ten numbers from 100 to 190. As before, the value of E gets set to each number in turn until we come to one that's greater than the ERRORLEVEL. Variable E ends up equal to 15.

Finally, the last line checks the ten numbers from 150 to 159, and 155 is the highest number that's not greater than the ERRORLEVEL. E ends up containing 155, the correct value.

So what's the problem? ERRVAR

.BAT tests the ERRORLEVEL against the numbers from 0 to 299. But the IF ERRORLEVEL *n* test assumes that *n* is between 0 and 255. If it's larger, it's treated *modulo* 256; thus, 256 corresponds to 0, 257 to 1, and so on. Most important, 299 corresponds to 43. Thus testing results in a false positive, and ERRVAR.BAT will return 299 for any ERRORLEVEL of 200 or more.

ERRVAR2.BAT (Figure 4) is a fixed-up version that handles *any* ERRORLEVEL. It simply avoids testing numbers over 255. If the first digit is 2, it doesn't test second digits over 5. If the first two digits are 25, it doesn't test third digits over 5. You can insert these lines in any batch file, or better yet just CALL ERRVAR2 when you want to get the ERRORLEVEL into an environment variable.

ANOTHER METHOD FOR DETECTING VIRUSES

One form of virus protection is to regularly monitor your hard disk for changes in critical system areas. If you keep an "imprint" of your system (that is, "authentic" copies of the boot record, COMMAND.COM, IBM-BIO.COM, and IBMDOS.COM) stored away safely, the DOS COMP utility makes a health check not only possible, but easy and fast. All you have to do is COMPare your current files against the originals. If

ERRVAR.BAT

COMPLETE LISTING

```
ECHO OFF
SET E=
FOR %%q IN (0 1 2) DO IF ErrorLevel %%q00 SET E=%%q
FOR %%q IN (%E%0 %E%1 %E%2 %E%3 %E%4 %E%5 %E%6 %E%7 %E%8 %E%9) DO IF ErrorLevel %%q0 SET E=%%q
FOR %%q IN (%E%0 %E%1 %E%2 %E%3 %E%4 %E%5 %E%6 %E%7 %E%8 %E%9) DO IF ErrorLevel %%q SET E=%%q
```



Figure 3: This batch file converts any ERRORLEVEL into an environment variable, as long as it's under 200.

User-to-User

they are different, you know that there is probably something wrong.

If you object that COMP can't do anything with the boot record—that it is not a file, but a physical area (sector 0) on the disk—you're right. That's why I wrote NOVIRUS.BAT (Figure 5). It uses DEBUG's ability to read any specified disk sector and write it as a file, which COMP can handle. It

If you keep an "imprint" of your system (your boot record and system files) stored safely, the DOS COMP utility makes a health check not only possible, but easy and fast.

then COMPares this copy and the current system files to the originals and displays the results. NOVIRUS.BAT assumes DEBUG is available on your PATH.

Before you can use NOVIRUS.BAT, you have to do as follows:

- Create a C:\CHKVIRUS directory on your hard disk.
- UnHide IBMBIO.COM and IBMDOS.COM with the PC Magazine utility ATTR.COM. Make copies of these files and of COMMAND.COM with the extension .ORI in the same directory. And hide IBMBIO.COM and IBMDOS.COM again.
- Type in NOVIRUS.BAT and NOVIRUS.SCR (Figure 6). Be careful when typing NOVIRUS.SCR—a carriage return after the final Q is essential. Redirect NOVIRUS.SCR into DEBUG with the command

```
DEBUG < NOVIRUS.SCR
```

It will create a file called BOOTREC.NOW. Rename this to BOOTREC.ORI.

When you are finished, your

NOVIRUS.BAT

COMPLETE LISTING



```
ECHO off
C:
CD \CHKVIRUS
CLS
ECHO .
ECHO NOVIRUS.BAT
ECHO Checks current system files against original files
ECHO .
ECHO *** WARNING ***
ECHO If you wish to quit (Ctrl-Break) DO IT NOW.
ECHO Do NOT stop this procedure after it has started!
ECHO .
PAUSE
ATTR -r bootrec.now > nul
ATTR -r *.log > nul
ECHO .
ECHO 1. DEBUG reading current Boot Record...
ECHO .
DEBUG < NOVIRUS.SCR > NUL
ECHO .
ECHO Current Boot Record written to file.
ECHO .
ECHO 2. Comparing current Boot Record with original...
DEL prevchek.log
REN thischek.log prevchek.log
ECHO N | comp bootrec.now bootrec.ori > thischek.log
ECHO N
ECHO 3. Comparing current COMMAND.COM with original...
ECHO N | COMP \command.com command.ori >> thischek.log
ECHO N
ECHO 4. Comparing current IBMBIO.COM with original...
ATTR -h -s \IBMBIO.COM > nul
ECHO N | COMP \IBMBIO.COM IBMBIO.ORI >> thischek.log
ATTR +h +s \IBMBIO.COM > nul
ECHO N
ECHO 5. Comparing current IBMDOS.COM with original...
ATTR -h -s \IBMDOS.COM > nul
ECHO N | COMP \IBMDOS.COM IBMDOS.ORI >> thischek.log
ECHO N
ATTR +h +s \IBMDOS.COM > nul
ATTR +r *.* > nul
ECHO .
MORE < thischek.log
ECHO .
PAUSE
ECHO .
ECHO End of virus checks. If COMPares not OK:
ECHO .
ECHO A. Take a deep, slow breath
ECHO B. Study COMPare results (files \CHKVIRUS\*.LOG)
ECHO C. Replace damaged files with .ORI files
ECHO D. Before using any diskette, make sure it is WRITE-PROTECTED!
```

Figure 5: NOVIRUS.BAT detects changes to the most-essential parts of your system. This is one step toward protecting your system against computer viruses.

CHKVIRUS directory should contain the following files:

```
BOOTREC.ORI
COMMAND.ORI
IBMBIO.ORI
IBMDOS.ORI
NOVIRUS.BAT
NOVIRUS.SCR
```

(This is for PC-DOS only. If you're using MS-DOS, replace IBMBIO.COM with IO.SYS and IBMDOS.COM with MSDOS.SYS and edit the batch file accordingly.)

You are now ready to run NOVIRUS.BAT. Note that after the first time you run it, all of the files in the CHKVIRUS directory will be read-only. If you want to modify any

of them, just enter ATTR -r *.* first.

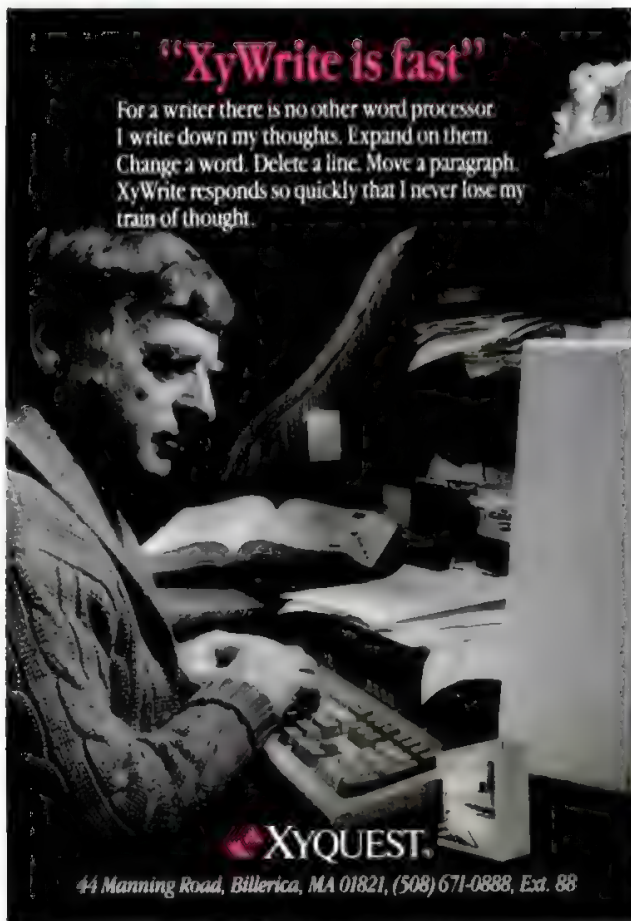
I have successfully used this system on several computers. The whole process (excluding PAUSEing time) takes less than a minute, even on a slow machine. I have included it in my AUTOEXEC.BAT and I run it every time I use a floppy disk or a program of unknown origin.

One final warning: don't expect 100 percent protection from this system. If some alien being looks for your 123.COM and turns it into a command to wipe out all .WK1 files, NOVIRUS.BAT won't notice. And if your system already has been infected when you make your "authentic" .ORI copies, then you are indeed out of luck.

Giovanni Borla
Milan, Italy

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User-to-User

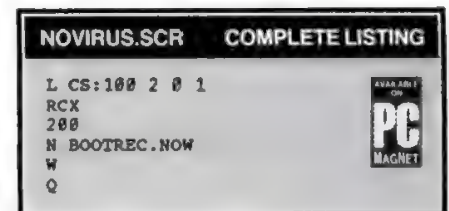


Figure 6: This script copies your hard disk's boot record to a file called BOOTREC.NOW.

Mr. Borla's idea was good, but his implementation required you to own *The Norton Utilities*. I rewrote his letter and batch file to use DEBUG instead. The only utility you will need that doesn't come with DOS is ATTR.COM, *PC Magazine's* file-attribute-changing program (June 10, 1986), which you can download from PC MagNet. DOS's ATTRIB command isn't enough in this case, because it doesn't let you change the Hidden attribute.

Both of the NOVIRUS files assume you're booting from drive C:. If not, you'll have to make some changes. First, near the top of NOVIRUS.BAT, change C: to the drive where your boot disk is located. Second, change the first line of NOVIRUS.SCR. It now reads

```
L CS:100 2 0 1
```

This tells DEBUG to Load disk information to the address CS:100 from drive 2, sector 0, for a total of 1 sector. You need to change the 2 to the appropriate number: drive A: is 0, B: is 1, C: is 2, and so forth.

This technique won't make your system "virus proof," but it will catch changes to the most important elements in your system. And it will also catch any accidental damage to those elements. NOVIRUS.BAT doesn't care whether a malicious program changed COMMAND.COM or you did it yourself by accident.

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edited by
Craig L. Stark

Power User

CHANGING OUTLINE HEADINGS

The outline function in *Microsoft Word*, Version 4.0, will not let you use <Alt 0> to lower a heading more than one level below the previous heading. This can be bothersome if you need to skip levels and don't want to create dummy headings. However, you can use the following macro to lower the heading to any level you need:

```
<enter><alt 0><up><del>
```

To use it, you must be in Outline View and have the cursor at the beginning of a paragraph that is already designated as some level heading. (Once in Outline View, you can change a text paragraph to a heading by hitting <Alt 9>.)

The macro creates a dummy heading, lowers the level of the current heading by one, then deletes the dummy heading. This works because *Word* will let you delete a heading at a given level without affecting headings nested at lower levels.

David Chen
Downsview, Ontario
Canada



This is a reasonably elegant solution to a ticklish problem. However, I'd be inclined to use styles instead. *Microsoft Word* will let you define paragraph formats for up to seven levels. To create each format, go to the Gallery, then choose Insert and follow the menu choices. For example, for the first level heading, use H1 for the keycode, Paragraph for usage, then tab over to Variant, hit <F1>, and choose Heading Level 1 from the listing.

Once you've created the styles, you can assign levels simply by putting the cursor in the paragraph and entering the keycode—<Alt h>1 for first level, <Alt h>2 for second level, and so on. *Word* won't care how this level compares with the level of the paragraph before.

Note that this approach works just as well for changing levels as for assigning them, and, of course, you can use the

■ **CHANGING OUTLINE HEADINGS:** Now you can create headings at any level in the outlining feature of *Microsoft Word*.

■ **FORCING A WORD COUNT:** When *Microsoft Word* balks, here's how to get a word count anyway.

■ **SPLIT-SCREEN COMPARISONS:** ALTG.WPM lets you easily examine two *WordPerfect* documents.

stylesheet to automatically control paragraph and character formats at each level. Another bonus is that you don't have to be in Outline View to assign or change levels. The one drawback to using styles is that you can only go to seven levels deep. However, if that's not enough, you can fall back to Mr. Chen's macro for any level beyond seven.—*M. David Stone*

FORCING A WORD COUNT

Repaginating in *Microsoft Word*, Version 4.0, does not always give a word count—a problem that will crop up in the word-count macro by John Britton (*Power User*, December 27, 1988). In fact, *Word* will only give a word count if the first page of the document has been modified since the previous word count. The macro

```
<Ctrl PgUp><space><Backspace>  
<Esc>PR
```

solves the problem by going to the top of the document, inserting a space, and then erasing that space. It then calls up the Print Repagate menu and waits for you to hit Enter. (As Mr. Britton points out, this prevents the End of Macro message from overwriting the word count on-screen).

Word accepts this erased space as a modified first page and obediently produces a word count.

Joe Kamiya
San Francisco, California



Oddly, *Word* only loses the word count function if you repaginate without confirming page breaks. If you choose to confirm page breaks and then answer yes to each suggested break, you get a word count even if you have made no changes in the document. You can also get a word count on an unchanged document if you save the document and reload it.

Note that this problem will not show up in the macro I suggested in response to Mr. Britton. That macro assumes there will be some text at the beginning of the document (such as a title) that you'll want to format as hidden so that *Word* won't count it. Reformatting the text as hidden also serves to reset *Word* to give a word count.—*M. David Stone*

SPLIT-SCREEN COMPARISONS

I have created a macro that lets you compare two *WordPerfect* documents in split-screen. Before invoking the ALTG.WPM macro, shown in Figure 1, the user should retrieve two files he wishes to compare. One file goes into Doc 1 and the other into Doc 2. The user then invokes the macro by pressing Alt-G. Instantly, the screen divides into 2 12-line documents. The document where the prompt appears will be referred to as the *operations doc* and the other as the *other doc*. A main menu prompt will appear at the bottom of the operations document.

From the main menu prompt, hitting the following number keys will produce the corresponding effects:

- 1—Operations doc screen will scroll down one line.
- 2—Operations doc screen will scroll up one line.
- 3—Other doc screen will scroll down one line.

Power User

- 4—Other doc screen will scroll up one line.
- 5—Both screens will scroll up two lines.
- 6—Both screens will scroll down two lines.

Pressing and holding keys 1 through 6 will cause a continuous scroll of the respective screen or screens. ALTG.WPM does not have an effective brake—stacked-up keypresses will continue to repeat after you release the key. This means some practice is required to cause the scrolling to stop at a desired point.

Hitting 7 will replace the main menu prompt with an exit menu prompt. The exit options produce the following effects:

- 1—Restores the operations doc to a full 24-line screen, exits the macro, and permits normal editing. The other doc will be accessible by pressing Switch (Shift-F3).
- 2—Restores the other doc to a full, 24-line screen, exits the macro, and permits normal editing. The operations doc will be accessible by pressing Switch (Shift-F3).
- 3—Preserves the split screen, exits the macro, and permits normal editing of the operations doc. The other doc will be visible. To access the other doc, the user would press Switch (Shift-F3).

When building this macro, you'll have to use Alt-24, Alt-25, and Alt-22 to create the up arrows, down arrows, and rectangular concept dividers, respectively. The imbedded IF statements allow the program to make logical decisions. These decisions will move the cursor to the top or bottom of the screen before scrolling up or down, depending upon where the cursor was last positioned.

Donald E. Moses
San Diego, California



In editing submissions for this column, I often use a grammar-checking program. I don't like allowing that program to modify my working text, so I have it create a separate marked-up text. This macro is perfect for comparing the original and marked versions. I can scroll either or both of the documents to keep the original text in sync with the marked version.

Use the built-in macro editor to create ALTG.WPM—you can't enter it from the keyboard. To get into the editor, you must attempt to redefine an existing macro, so create an empty macro called ALTG. Then try to define it again; you'll get the menu. Choose E for Edit and A for Action. Now

ALTG.WPM

```
{DISPLAY ON}
{ON ERROR}{GO}mnu""
{Screen}112{Enter}
{ASSIGN}3~6~
{ASSIGN}4~6~

{LABEL}mnu""
{CHAR}2~This-Screen-1=↓·2=↑~·Other
·Screen-3=↓·4=↑
~·5=zoom·↑·6=zoom·↓~·7=exit~

{IF}{VAR 2}=1~
{IF}{VAR 3}=1~
{ELSE}
{Home}{Up}
{ASSIGN}3~1~
{END IF}
{Up}
{GO}mnu""
{END IF}

{IF}{VAR 2}=2~
{IF}{VAR 3}=2~
{ELSE}
{Home}{Down}
{ASSIGN}3~2~
{END IF}
{Down}
{GO}mnu""
{END IF}

{IF}{VAR 2}=3~
{Switch}
{IF}{VAR 4}=3~
{ELSE}
{Home}{Up}
{ASSIGN}4~3~
{END IF}
{Up}{Switch}
{GO}mnu""
{END IF}

{IF}{VAR 2}=4~
{Switch}
{IF}{VAR 4}=4~
{ELSE}
{Home}{Down}
{ASSIGN}4~4~
{END IF}
{Down}{Switch}
{GO}mnu""
{END IF}
```

```
{IF}{VAR 2}=5~
{IF}{VAR 3}=2~
{ELSE}
{Home}{Down}
{ASSIGN}3~2~
{END IF}
{Down}{Down}{Switch}
{IF}{VAR 4}=4~
{ELSE}
{Home}{Down}
{ASSIGN}4~4~
{END IF}
{Down}{Down}{Switch}
{GO}mnu""
{END IF}

{IF}{VAR 2}=6~
{IF}{VAR 3}=1~
{ELSE}
{Home}{Up}
{ASSIGN}3~1~
{END IF}
{Up}{Up}{Switch}
{IF}{VAR 4}=3~
{ELSE}
{Home}{Up}
{ASSIGN}4~3~
{END IF}
{Up}{Up}{Switch}
{GO}mnu""
{END IF}

{IF}{VAR 2}=7~

{CHAR}3~1=Edit·this·screen~··2=
Edit·other·screen~··
3=Preserve·split·screen~
{IF}{VAR 3}=1~
{Screen}124{Enter}
{QUIT}
{END IF}

{IF}{VAR 3}=2~
{Switch}{Screen}124{HPg}
{QUIT}
{END IF}

{IF}{VAR 3}=3~
{Switch}{Switch}
{QUIT}
{END IF}
{END IF}
```



Figure 1: This macro lets you scroll through two different documents in split-screen WordPerfect.

use the editor to construct a macro that matches Figure 1. When you get to the special characters, the arrows, and the block, hold down the Alt key, tap out the number on the *numeric keypad*, and then release Alt.

WordPerfect doesn't actually have a command to scroll the screen, so this macro has to fake it. To scroll down, it has to move to the top of the screen ({Home}{Up}) and *push* the text down by going up one line. Of course, if it's already at the top, it mustn't give the {Home}{Up} command—that would go to the top of the next screen.

Within the macro, variable 3 tracks the cursor position in the operations doc. A value of 1 means it's at the top of the current window; 2 means it's at the bottom. Variable 4 performs the same function for

the other doc—a value of 3 means top; 4 means bottom. If the macro looks intimidating, study it carefully and trace its operation. You'll learn something about variables and IF conditions in WordPerfect macros.—Neil J. Rubenking

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Your Name: First		Initial	Last	Date of Birth: Mo. Day Yr		Social Security Number:	
Present Address: Street		Apt. #	City	State	Zip	Home Phone () -	
Date of Residence: Month Year		Monthly Payment: \$				Buy ☐ Rent ☐ Other ☐	
Previous Address:		Dates of Residence: From To					
Your Employer: (If self-employed, see rear panel)		Date of Employment: Mo. Yr		Position:		Monthly Income: Gross \$ Net \$	
Employer's Address: Street		City	State	Business Phone: () -			
Previous Employer:		Address:		Dates of Employment: From To			
Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation		Other Income: I have received since (Date)		Monthly Income: Gross \$ Net \$			
Name and Address of Nearest Relative Not Living With You:				Relationship			

b. Credit Information

Include joint applicant's information, if joint account requested

Bank Account:	Bank Name	Address	☐ Checking	☐ Savings
Bank Account:			☐ Checking	☐ Savings
Bank Loan Reference:			Payment	Balance
Bank Card Reference:	☐ VISA	☐ Mastercard		
Other Credit Card Reference:				
Other Credit References:	Account No.	Expires:		

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Address: Street		Apt. #	City	State	Zip	Home Phone () -	
Employer:		Date of Employment: Mo. Yr		Position:		Monthly Income: Gross \$ Net \$	
Employer's Address: Street		City	State	Business Phone: () -			

d. Self-Employed Information

Complete this section only if you are self employed

Business Name		Proprietorship		Corporation	Partnership
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Description of Business		Your Position		In Business Since	
Your annual income from business		Business' annual income (gross)		(net)	
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edited by
Tony Rizzo

Languages

SIMULATE THE BASIC PLAY STATEMENT

Wouldn't it be great to be able to play the piano on your computer? Of course, there's a way to do it in BASIC using the PLAY command, but there is no PLAY procedure included in the standard library of Turbo Pascal 4.0. To overcome this lack, I wrote a PLAY procedure on my own, using the Sound procedure and a simple formula to calculate the hertz (cycles per second) for each note.

The formula is

```
exp((o + n div 12) * ln(2))
```

where *o* is the octave and *n* is the note in the octave. It figures out the hertz for any note in any octave (including octaves not on the standard piano keyboard). The tempo is specified as the number of quarter notes in a minute.

Figure 1 shows the commands supported by the PLAY procedure. Note that when you try to play a note, the parameters that follow must be in order. You can omit any or all of these parameters, but make sure that when you list them in your command string, they are listed in the order shown.

The octave number for this procedure must be in the range of 1 to 7. The PLAY procedure will add 3 to this number for the calculation of the note in hertz, since absolute octaves 1 to 3 don't play properly and are not on the piano keyboard. The tempo is set for the number of quarter notes to play in 1 minute. The length for following notes in milliseconds is determined by $(1/n) * (t \text{ div } 60) * 1000$, where *n* is the given number and *t* is the tempo.

The source code for PIANO.PAS in Figure 2 provides the listing for the PLAY procedure and contains an example that uses PLAY to play "Jingle Bells." The first statement, `Play('T255MNO5L4');`, sets tempo=255, music type=normal, octave=5, and tells the procedure to play quarter notes. This is an initialization for the play procedure. You can change this initialization to do what you want when it starts up,

■ **SIMULATE THE BASIC PLAY STATEMENT:** Use this Turbo Pascal PLAY routine to create the functionality of the BASIC PLAY statement.

but make sure you include the following: tempo, music type, octave number, and length of the following notes.

If this command (or one like it) is not executed, the variables will not be set correctly and running the PLAY procedure will have unexpected results. Make sure that this

command is executed at the beginning of your program.

The PLAY procedure will accept up to 255 characters in the command string. If there are any unrecognized commands in the string, the procedure simply skips over them and reads the next command. Once the command string has been read and executed, the procedure ends.

James Simister
Salt Lake City, Utah



Exponents and logarithms are among the slowest functions Turbo Pascal can perform. Also, their results are less accurate than simpler functions like multiplication. Note that the



COMMAND STRING COMPONENTS FOR THE PLAY PROCEDURE

CODE	FUNCTION
A-G	Plays the corresponding note on the computer speaker. A "+" after a note means a sharp. A "-" after a note means a flat. A number after a note changes the length of that note only. A "." after a note means to add half the length of the previous added length.
Note:	You can add as many of these as you like. For example, "A." equals $1 + \frac{1}{2}$ or $\frac{3}{2}$; "A.." equals $1 + \frac{1}{2} + \frac{1}{4}$ or $\frac{7}{4}$; etc. If you wish to add more than one parameter per note, do so in the order listed: a sharp or a flat, length for that note, and then the '.'s. Any of these can be omitted, but what is used should be listed in the order given. For example, "A+4." means to play A sharp as a quarter note plus an eighth note longer. "A+." means to play A sharp at $\frac{1}{2}$ longer than the current length.
On	Octave Command—Changes the octave to <i>n</i> , where <i>n</i> = 1 to 7; or <i>n</i> = + to increment octave; <i>n</i> = - to decrement octave. To select middle C, use Octave 4, note C.
Ln	Length Command—Sets the length of the note to $1/n$, where <i>n</i> = 1 for a whole note, <i>n</i> = 2 for a half note, <i>n</i> = 4 for a quarter note, etc. <i>n</i> cannot be less than 1 or greater than 64.
Pn	Pause Command—Pauses for the length $1/n$, where <i>n</i> = 1 for a whole note pause, <i>n</i> = 2 for a half note pause, etc. <i>n</i> can't be less than 1 or greater than 64.
Tn	Tempo Command—Sets the tempo to <i>n</i> , where <i>n</i> can't be less than 32 or greater than 255. The default is set to 120.
MN	Sets music to normal (note plays $\frac{7}{8}$ time set by Ln).
ML	Sets music to legato (note plays full time).
MS	Sets music to staccato (note plays $\frac{3}{4}$ time).

Figure 1: Here are the commands supported by the PLAY procedure. Any or all of them may be omitted, but if used, they must be listed in the command string in the order shown.

Languages

PLAY procedure presented here has to perform a calculation involving exponents and logarithms for every note it plays.

Figure 3 shows variable declarations and routines that improve PIANO.PAS.

You can just add them to the source code—put the variables at the end of the variable declaration and add the routines before any other routines. Add a call to SetFrequencies at the start of the program, and replace the line

```
sound(Round(Exp((octave+intern/12)
*Ln(2))));
```

with the following statement:

```
sound(Hertz(o, intern));
```

You will notice that the pitch is now slightly lower than it was before. This is because the Hertz procedure returns the normal 440 for the standard tuning A, while the exponent calculation returns the

PIANO.PAS	COMPLETE LISTING
<pre> PROGRAM Piano; USES CRT; VAR vari : Integer; test, dly, intern, dlykeep : LongInt; flager, chartoplay : Char; numb, octave : Integer; typom, min1, adder : Real; PROCEDURE Play(SoundC : STRING); FUNCTION IsNumber(ch : CHAR) : Boolean; BEGIN IsNumber := (ch >= '0') AND (ch <= '9'); END; FUNCTION value(s : STRING) : Integer; (Converts a string to an integer) VAR ss, sss : Integer; BEGIN Val(s, ss, sss); value := ss; END; PROCEDURE sounder(key : Char; flag : Char); (Plays the selected note) VAR old, New, new2 : Real; BEGIN adder := 1; old := dly; New := dly; intern := Pos(key, 'C D E F G A B')-1; IF (flag = '+') AND (key <> 'E') AND (key <> 'B') (See if note) THEN Inc(intern); (is sharp) IF (flag = '-') AND (key <> 'F') AND (key <> 'C') THEN Dec(intern); (or a flat.) WHILE SoundC[vari+1] = '.' DO BEGIN Inc(vari); adder := adder/2; New := New*(old*adder); END; new2 := (New/typom)*(1-typom); sound(Round(Exp((octave+intern/12)*Ln(2)))); (Play the note) Delay(Trunc(New)); Nosound; Delay(Trunc(new2)); END; FUNCTION delayer1 : Integer; (Calculate delay for a specified note length) BEGIN numb := value(SoundC[vari+1]); delayer1 := Trunc((60000/(numb*min1))*typom); END; FUNCTION delayer2 : Integer; (Used as above, except reads a number >10) BEGIN numb := value(SoundC[vari+1]+SoundC[vari+2]); delayer2 := Trunc((60000/(numb*min1))*typom); END; BEGIN (Play) SoundC := SoundC+' '; FOR vari := 1 TO Length(SoundC) DO BEGIN (Go through entire string) SoundC[vari] := Uppcase(SoundC[vari]); ('Get a char and convert to CAPS) CASE SoundC[vari] OF 'C','D','E','F','G','A','B' : BEGIN ('Check to see if char is a note) flager := ' '; dlykeep := dly; chartoplay := SoundC[vari]; IF (SoundC[vari+1] = '-') OR (SoundC[vari+1] = '+') THEN BEGIN (Check for flats & sharps) flager := SoundC[vari+1]; Inc(vari); END; IF IsNumber(SoundC[vari+1]) THEN BEGIN IF IsNumber(SoundC[vari+2]) THEN BEGIN test := delayer2; IF numb < 65 THEN dly := test; (Make sure 0 is legal) Inc(vari, 2); END; ELSE BEGIN test := delayer1; IF numb > 0 THEN dly := test; (Make sure 0 is legal) Inc(vari); END; END; END; ELSE BEGIN test := delayer1; IF numb > 0 THEN dly := test; (Make sure 0 is legal) Inc(vari); END; END; END; END; END; END; (Check for a change in length for notes) 'L' : IF IsNumber(SoundC[vari+1]) THEN BEGIN IF IsNumber(SoundC[vari+2]) THEN BEGIN test := delayer2; IF numb < 65 THEN Delay(test); (Make sure 0 is legal) Inc(vari, 2); END; ELSE BEGIN test := delayer1; IF numb > 0 THEN Delay(test); (Make sure 0 is legal) Inc(vari); END; END; END; END; (Check for a pause and it's length) 'P' : IF IsNumber(SoundC[vari+1]) THEN BEGIN IF IsNumber(SoundC[vari+2]) THEN BEGIN test := delayer2; IF numb < 65 THEN Delay(test); (Make sure 0 is legal) Inc(vari, 2); END; ELSE BEGIN test := delayer1; IF numb > 0 THEN Delay(test); (Make sure 0 is legal) Inc(vari); END; END; END; END; (Check for tempo change) 'T' : IF IsNumber(SoundC[vari+1]) AND IsNumber(SoundC[vari+2]) THEN BEGIN IF IsNumber(SoundC[vari+3]) THEN BEGIN min1 := value(SoundC[vari+1]+SoundC[vari+2]+SoundC[vari+3]); Inc(vari, 3); IF min1 > 255 THEN min1 := 255; (Make sure 0 isn't too big) END; ELSE BEGIN min1 := value(SoundC[vari+1]+SoundC[vari+2]); IF min1 < 32 THEN min1 := 32; (Make sure 0 isn't too short) END; END; min1 := min1/4; END; END; (Check for music type) 'M' : BEGIN Inc(vari); CASE Uppcase(SoundC[vari]) OF 'M' : typom := 7/8; (Normal) 'L' : typom := 1; (Legato) 'S' : typom := 3/4; (Staccato) END; END; END; (Play Jingle Bells) Play('T255MHO514'); Play('CAGFC2.P4C8C8CAGFD2.P4DB-AGE2.P4O6CCO5B-GA2.P4CAGFC2'); Play('P4CAGFD2P4DDB-AGOGCCCCO3B-GF2O6C2O5'); Play('AAA2AAA2AO6CO5F.G8A2.P4B-B-B-B-8B-AAA8A8'); Play('AGGAG2O6C2O5'); Play('AAA2AAA2AO6CO5F.G8A2.P4B-B-B-B-8B-AAA8A8'); Play('O6CCO5B-GF2'); END. (PIANO) </pre>	<pre> IF numb > 0 THEN dly := test; (Make sure 0 is legal) Inc(vari); END; END; sounder(chartoplay, flager); dly := dlykeep; END; 'O' : BEGIN (Check for octave change) Inc(vari); CASE SoundC[vari] OF '-' : IF octave > 1 THEN Dec(octave); '+' : IF octave < 7 THEN Inc(octave); '1','2','3','4','5','6','7' : octave := value(SoundC[vari])*4; ELSE Dec(vari); END; END; (Check for a change in length for notes) 'L' : IF IsNumber(SoundC[vari+1]) THEN BEGIN IF IsNumber(SoundC[vari+2]) THEN BEGIN test := delayer2; IF numb < 65 THEN dly := test; (Make sure 0 is legal) Inc(vari, 2); END; ELSE BEGIN test := delayer1; IF numb > 0 THEN dly := test; (Make sure 0 is legal) Inc(vari); END; END; END; END; (Check for a pause and it's length) 'P' : IF IsNumber(SoundC[vari+1]) THEN BEGIN IF IsNumber(SoundC[vari+2]) THEN BEGIN test := delayer2; IF numb < 65 THEN Delay(test); (Make sure 0 is legal) Inc(vari, 2); END; ELSE BEGIN test := delayer1; IF numb > 0 THEN Delay(test); (Make sure 0 is legal) Inc(vari); END; END; END; END; (Check for tempo change) 'T' : IF IsNumber(SoundC[vari+1]) AND IsNumber(SoundC[vari+2]) THEN BEGIN IF IsNumber(SoundC[vari+3]) THEN BEGIN min1 := value(SoundC[vari+1]+SoundC[vari+2]+SoundC[vari+3]); Inc(vari, 3); IF min1 > 255 THEN min1 := 255; (Make sure 0 isn't too big) END; ELSE BEGIN min1 := value(SoundC[vari+1]+SoundC[vari+2]); IF min1 < 32 THEN min1 := 32; (Make sure 0 isn't too short) END; END; min1 := min1/4; END; END; (Check for music type) 'M' : BEGIN Inc(vari); CASE Uppcase(SoundC[vari]) OF 'M' : typom := 7/8; (Normal) 'L' : typom := 1; (Legato) 'S' : typom := 3/4; (Staccato) END; END; END; END; (Play Jingle Bells) Play('T255MHO514'); Play('CAGFC2.P4C8C8CAGFD2.P4DB-AGE2.P4O6CCO5B-GA2.P4CAGFC2'); Play('P4CAGFD2P4DDB-AGOGCCCCO3B-GF2O6C2O5'); Play('AAA2AAA2AO6CO5F.G8A2.P4B-B-B-B-8B-AAA8A8'); Play('AGGAG2O6C2O5'); Play('AAA2AAA2AO6CO5F.G8A2.P4B-B-B-B-8B-AAA8A8'); Play('O6CCO5B-GF2'); END. (PIANO) </pre>

Figure 2: Here is the source-code listing for the PLAY routine.

Languages

slightly higher result of 456.

There are many free programs available on bulletin boards that play popular tunes

using the BASIC PLAY statement. With this routine, you can play most of them in your Turbo Pascal programs.

You should note that there are a few differences between the Turbo Pascal version and the BASIC PLAY statement.

■ Octaves 1 to 7 in the Pascal version cor-

respond to BASIC octaves 0 to 6.

■ The > and < commands, which raise and lower the octave, are replaced by O+ and O-.

■ The Pascal version doesn't support the N command. In BASIC you can specify any one of the 84 possible notes (12 notes in 7 octaves) by N plus a number ranging from 1 to 84.

■ You can't use X to eXecute another string.

■ Background music isn't available in the Turbo Pascal version, so the MB and MF commands, which turn background music on and off in BASIC, have no effect.

—Neil J. Rubenking

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HERTZ FUNCTION	COMPLETE LISTING
<pre> VAR Oct_Val : ARRAY[5..12] OF Real; Freq_Val : ARRAY[0..12] OF Real; PROCEDURE Set_Frequencies; VAR N : Byte; BEGIN Freq_Val[1] := 1; Freq_Val[2] := 1.0594630944; FOR N := 3 TO 12 DO Freq_Val[N] := Freq_Val[N - 1] * Freq_Val[2]; Freq_Val[0] := 1/Freq_Val[2]; Oct_Val[5] := 32.70319566; FOR N := 6 TO 12 DO Oct_Val[N] := Oct_Val[N - 1] * 2; END; FUNCTION Hertz(Oct, nt : byte) : Word; BEGIN Hertz := Round(Oct_Val[Oct]*Freq_Val[nt]); END; </pre>	

Figure 3: Add these variable declarations and routines to PIANO.PAS's source code. The Hertz function shown here makes the PLAY procedure faster and more accurate.

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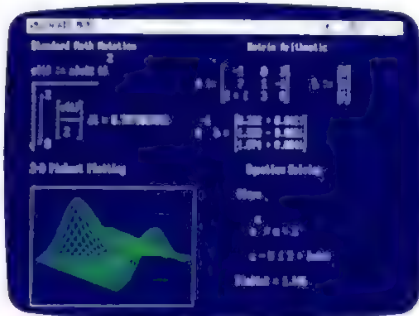
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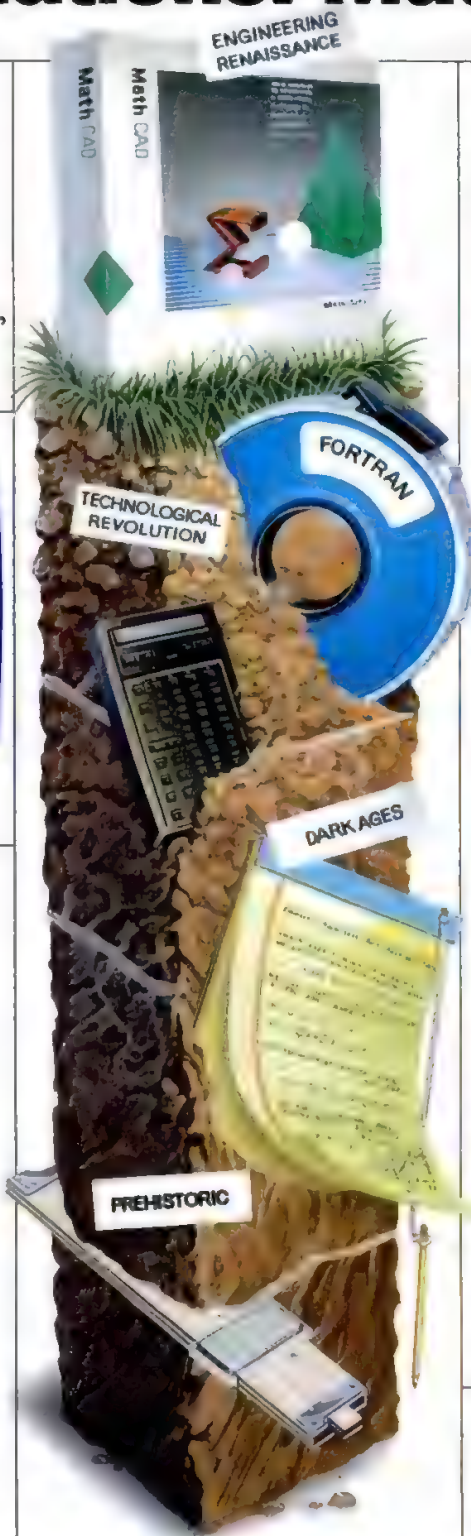


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by
Jeff Proise

Tutor

THE FIRST 30 SECONDS

What is the POST? Exactly what does the PC do from the time you turn on the power switch until the DOS prompt appears?

Terry Jefferson
Wichita, Kansas



Our reader asks a simple question, but the answer is rather lengthy. POST stands for power-on self-test. It's a set of diagnostic routines encoded in ROM that serves as your computer's first line of defense against unwanted gremlins; it also ensures that the hardware you entrust your data to has been checked and certified ready to go each time you power it up.

When you turn on your PC and see an error message indicating that a RAM chip has gone bad, that message is an outward sign that one of the POST's diagnostic routines failed. The POST validates every byte of memory in your system at startup with a series of read/write tests designed to ferret out bad RAM locations. When it finds one, it reports the problem—before you have a chance to lose data.

But testing RAM is only one of the POST's many responsibilities. Besides running reliability tests on your system board components, it configures the various support chips that work with the microprocessor, determines what optional equipment is attached, gives adapters the chance to initialize themselves, sets up the interrupt vector table in low memory, gets the keyboard ready to transmit keystrokes to the CPU, and invokes the bootstrap loader, which in turn loads the operating system. After this final step, you see the first evidence that the PC is up and running—the command-line prompt under DOS and the window-based Presentation Manager in OS/2.

To better understand this process, we'll trace the startup sequence followed by the original IBM PC, then double back to highlight the differences between its POST and the POSTs for the AT and PS/2. The complexity of the startup ROM has grown

■ **THE FIRST 30 SECONDS:**
The great mystery of what happens in the first 30 seconds after you turn on your machine is finally put to rest.

as hardware has evolved, but the same theme and general order of operations has been carried through from the very first PC to the most recent. Figure 1 is a general sketch of the various parts of a typical computer; it generally applies to both AT and Micro Channel computers.

The very first CPU-related event that takes place when power is applied to the microprocessor is execution of the instruction at address FFFFh:0000h. In the IBM PC, this instruction is a far jump to the beginning of the POST encoded in ROM in the upper 8K of segment F000h.

The startup ROM begins by exercising the CPU and trapping any errors or inconsistent handling of instructions. Six of the nine status flags—CF, ZF, SF, AF, OF, and PF—are individually set or cleared and tested with relative jump instructions whose destination (if the test fails) is an HLT instruction that simply halts the microprocessor. Each of the CPU's registers (with the exception of CS and IP, which are implicitly tested by the very execution of the routine) is written and read to verify that it is capable of handling data.

After verifying that the ROM containing the BIOS and startup code is intact, which it does by employing a checksum procedure, the POST turns to the 8253 timer chip. The 8253 provides three multi-purpose counter/timers for accurate timing of events under software control. Timer 0 is wired into the CPU through the 8259A programmable interrupt controller to generate timer interrupts at a frequency of roughly 18.2 times per second. Timer 1 is

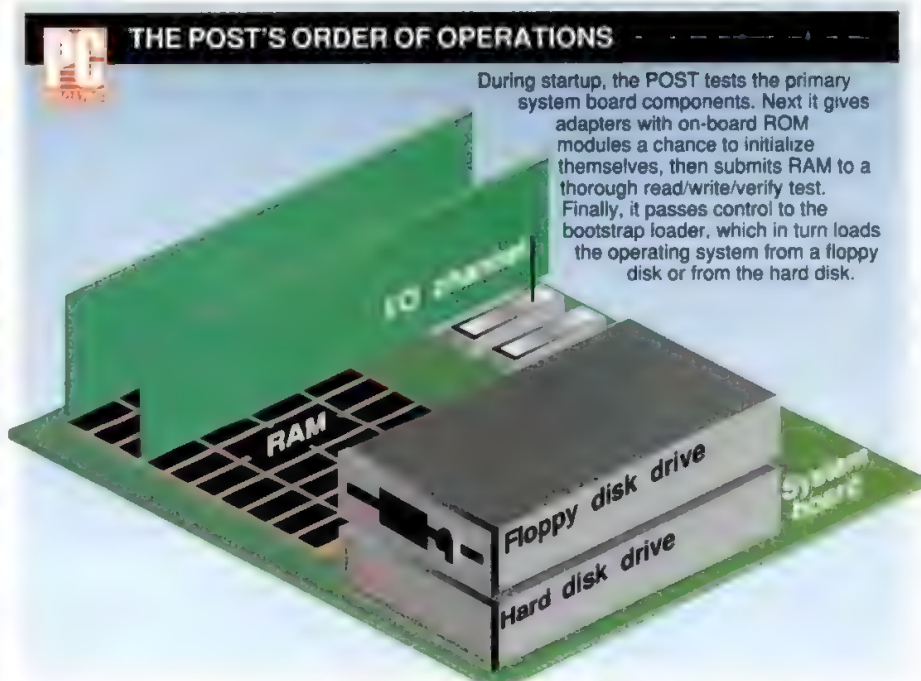


Figure 1: By testing the primary system board components (the CPU, DMA controllers, and interrupt controllers), the POST ensures that the system is working properly at the lowest levels.

Tutor

used to trigger dummy DMA (Direct Memory Access) transfer requests for periodic RAM refresh. Timer 2 is available for tone generation in the speaker and other multipurpose timing applications under user control (see the January 16, 1990, Tutor column for an in-depth discussion of how timer 2 can be used to measure time intervals in the sub-55-millisecond range). The POST tests timer 1 and initializes it to the proper refresh rate. Then it initializes timer 0, submits it to a crude frequency check, and configures it to produce a pulse (interpreted as an interrupt by the 8259A) every 65,536th clock cycle.

The 8253 is accompanied on the system board by an 8237 DMA controller. DMA is a mechanism for transferring data directly between memory locations without involving the CPU. On the PC, three of the 8237's four 20-bit DMA channels are used primarily to free the microprocessor from relatively slow disk I/O; the fourth is dedicated to memory refresh. Immediately after initializing the 8253, the POST subjects the registers of the 8237 to a write/read test and, if no problems are detected, begins the periodic memory refresh.

With dynamic RAM now up and available, the POST reads the system board DIP switches to determine how much memory is installed on the system board and expansion cards. The first 16K is subjected to a full integrity test while any remaining RAM is simply initialized to zero. Then the 8259A is set up to arbitrate interrupts arriving on its eight request lines, and the first 32 interrupt vectors are directed to a temporary interrupt service routine. The 8259A handles interrupts in the PC by prioritizing requests from external sources and passing them on one at a time to the CPU. After the 8259A is initialized, the POST tests it by masking off hardware interrupts and entering a do-nothing delay loop of approximately 1 second in duration. If no interrupts occur during that time, then the POST continues; otherwise, execution is abruptly stopped.

Finally, to round out the first phase of operation, the POST copies the proper values of interrupt vectors 10h through 1Fh to their respective slots in low memory.

With the most-basic pieces of hardware now working, the POST turns its attention to the video controller card. Switch block 1 is read, and the result is stored in the low

byte of the BIOS data area's equipment flag word. The POST determines the default video mode from sense switches 4 and 5 and calls function 0 of interrupt 10h to initialize the 6845 video controller, set up video parameters in the BIOS data area, clear the video buffer, position the cursor in the upper-left corner of the screen, and enable the video signal. The Motorola 6845 is the programmable CRT controller used in IBM's original CGA and MDA display adapters. For compatibility, the 6845 is partially emulated in today's higher-performance EGA and VGA adapt-

**You can insert an EGA
into a slot in an old PC
and the POST will still
work correctly.**

ers. As a result, you can insert an EGA into a slot in an old PC and the POST will still work correctly—even though it predated the EGA by several years.

Next, video RAM is subjected to a thorough write/read/verify test, and a single row of characters is written to the video buffer. To make sure the hardware is functioning properly, the POST delays long enough to verify that the vertical and horizontal retrace bits in the CRT status register periodically change polarity. Then, after clearing the screen, it makes a sweep of ROM address space between segments C000h and C800h in 2K increments, looking for video adapters with their own internal startup codes like the EGA. If any additional ROM modules are found, the POST transfers control to them long enough to let them perform their own specialized hardware initialization procedures.

Next comes the incremental memory check you see displayed on-screen on machines postdating the original PC. Every byte of RAM is written and read with all ones, all zeroes, and alternating checkerboard patterns to check for sympathetic, stuck, and unresponsive bits. Up to this point, the POST's general response to a test failure has been to shut down the system with no explanatory remarks or messages to the user. With video now functioning, however, a data compare or parity check error results in a 201 error code that

is displayed on your screen.

With memory now verified, the keyboard is reset, tested, and checked for stuck keys. An error produces a 301 message. Interrupt vectors 8 through 0Fh are set up, and a scan for adapter ROMs in the range of segment addresses C800h through F400h is initiated. A ROM module is identified by the word value 55AAh in its first storage location at offset 0. When a ROM module is found, the POST transfers control to it by effecting a jump to offset 3 in the ROM segment. By convention, the byte at offset 2 holds the length of the module expressed in the number of 512-byte blocks, while offset 3 holds the first byte of the adapter's internal startup code.

The final memory test performed is a simple checksum on the 32K BASIC ROM containing the interpreted BASIC kernel routines. The POST follows up by enabling disk interrupts, resetting the floppy disk controller, turning on the drive motor, delaying for one second, performing a seek, and shutting off the motor again. An error in any of these exercises produces a 601 indicator on your screen but does not halt execution.

With most of its work done, the POST does some miscellaneous housekeeping that includes setting up the remainder of the values not already defined inside the BIOS data area. The data area is a 256-byte RAM workspace at absolute address 400h used by the ROM BIOS. The POST sets up the keyboard buffer and enters default time-out values for parallel and serial ports. It also determines how many parallel and serial ports are attached and fills in their respective I/O addresses in the data area's communications address tables.

The final task the POST performs before calling the bootstrap loader is to enable NMI. NMI, or nonmaskable interrupt, is "nonmaskable" because it isn't routed through the 8259A and therefore can't be masked in the same sense that other interrupts can. It can, however, be enabled and disabled by toggling a latch accessed through an I/O port. NMI is used on the PC to report parity check errors and math coprocessor exceptions.

The POST ends by emitting one short beep from the PC's speaker and executing an interrupt 19h to invoke the bootstrap loader. The loader is charged with the task of loading an operating system from disk to get the machine running, without benefit of the operating system's high-level disk I/O services. The process is called

She's 5 years old. She's already had 7 names, 16 identities and 21 homes.

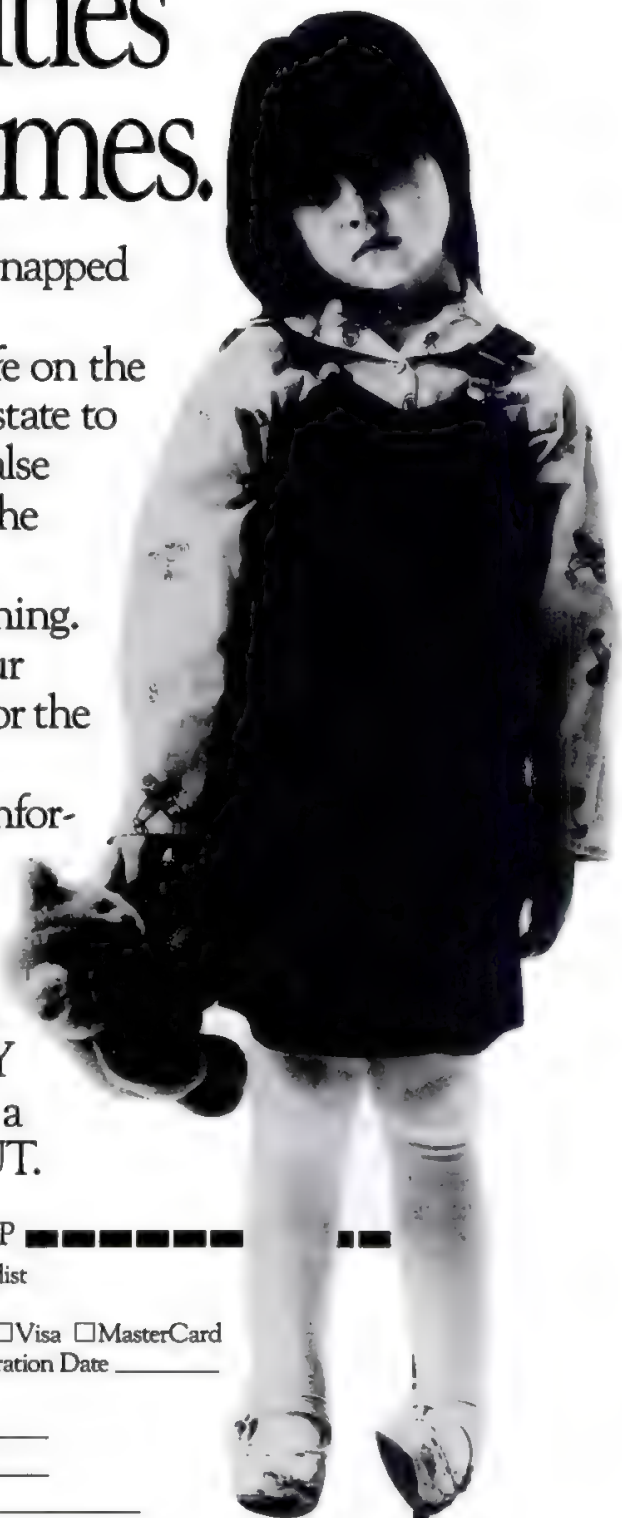
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bootstrapping because the PC figuratively pulls itself up by its bootstraps.

The interrupt 19h handler uses BIOS interrupt 13h to read the very first sector of the disk in drive A: (called the "boot sector" by DOS) and copy its contents to absolute address 7C00h. If the call succeeds, control is transferred to 7C00h with a JMP instruction. If no disk is present in the drive or if a drive malfunction prevents the sector from being read, the loader executes an interrupt 18h to invoke cassette BASIC.

On more contemporary machines such as the XT, the BIOS is smart enough to go to the hard disk before defaulting to BASIC if there is no disk in the A: drive. Getting an original PC to do the same requires a ROM upgrade. With a hard disk installed in the system, the sector read by the loader (the first physical sector on the disk) contains the master partition table and a fragment of code that inspects the table to determine which operating system is bootable. The boot sector belonging to the bootable operating system—found in the first *logical* sector of the corresponding partition—is loaded and given control.

If that operating system is PC-DOS, the bootstrapping code checks to see if the disk contains a copy of the operating system by reading the first sector of the root directory and looking for the hidden files IBMBIO.COM and IBMDOS.COM. The files must occupy the first two slots in the root directory. Moreover, IBMBIO.COM must lie in contiguous sectors beginning in the disk's first data sector. If these conditions are met, IBMBIO.COM is read into memory and handed control. IBMBIO.COM, in turn, loads IBMDOS.COM, which contains the DOS kernel.

IBMBIO.COM sets up interrupt vectors 20h through 3Fh and performs various other tasks required to get the operating system working. Among other things, it is responsible for initializing resident device drivers, processing the CONFIG.SYS file, loading installable device drivers, and structuring DOS's layout in memory to accommodate disk buffers, internal tables, file control blocks, and device drivers. It finishes up by calling the EXEC function to load and execute COMMAND.COM, or an alternative command processor if one was specified with the SHELL command in CONFIG.SYS.

It's the command processor that finally

brings up the DOS prompt. COMMAND.COM, DOS's default command processor, processes the AUTOEXEC.BAT file, then splits itself into a resident and a transient portion. The latter half is copied into high memory, where it can be overwritten if an application program needs the extra memory (if a program destroys the upper half, COMMAND.COM uses the COMSPEC variable to locate its image on disk and reload itself when the program ends). Its final act during startup is to display the DOS prompt in the format specified by the PROMPT environment variable and call

**IBMBIO.COM must lie
in contiguous sectors
beginning in the disk's
first data sector.**

DOS function 0Ah to read input from the keyboard—the point at which you can finally type a command.

Fundamental hardware differences between the PC and the AT dictate that the AT's POST routines be somewhat more sophisticated than the PC's. The AT POST, for example, checks for and initializes a hard disk immediately after initializing the first disk drive and attempts to boot from the hard disk if drive A: is empty. It checks the keyswitch on the front of the box to make sure the keyboard isn't locked. And it provides more-descriptive error messages when problems do occur.

Other AT hardware advancements required more subtle refinements to the POST. The AT, for example, uses a pair of cascaded 8259A interrupt controllers to double the number of hardware interrupt lines available. It also implements two 8237 DMA controllers in place of the single one found in the PC. In each case, two chips must be initialized rather than one. Another key difference arises from the AT's use of CMOS RAM to store configuration data. CMOS RAM is validated with a checksum process similar to the one used to check BIOS ROM, and hardware information is pulled from CMOS RAM rather than system board DIP switches.

But the most significant change made to the POST was driven by the AT's use of the 80286. The AT switches from real

mode to protected mode and back at least three times during startup. The first time, the POST determines how much of the 16-megabit address space is filled with RAM. The second time, all RAM above the first 64K is tested. Each time thereafter, one or more hardware functions essential to protected-mode operation are tested.

The bootstrapping process is more a function of the operating system than of the hardware it's running on and, in general, has remained relatively unchanged over time. But with the AT—and with 286 and 386 machines in general—comes the possibility that the operating system being loaded is OS/2 rather than DOS.

The OS/2 bootstrapping process is roughly analogous to DOS's. In Version 1.1, the bootstrap code locates and loads the system file OS2LDR, which in turn loads OS2KRNL. OS2KRNL immediately jumps into protected mode and initializes the various components of OS/2, then processes CONFIG.SYS and, based on the hardware configuration, loads OS/2's internal disk, keyboard, screen, clock, and printer device drivers. Finally, Presentation Manager is loaded. Presentation Manager completes the list of startup tasks, which includes processing the command file STARTUP.CMD and initializing the Start Programs window along with the Task Manager, DOS compatibility box, and print spooler icons, before giving the machine up to user control.

We know a little less about the PS/2 startup ROM because the PS/2 BIOS listings were never published—as were the PC and AT listings. From inference, we do know that the Personal System/2 POST routines form a superset of those found in the AT. The chief differences stem from the implementation of a power-on password and the programmable option select (POS) feature of the Micro Channel bus.

If a power-on password has been defined, the POST displays a keylike symbol on the screen and pauses until the user replicates the password from the keyboard. The password bytes are then locked in CMOS RAM so that no subsequent program can access them and defeat the protection scheme.

Immediately after the CPU and support chips are checked out and initialized (or, at least, the *equivalent* of the support chips; much of what was packaged in discrete chips in the PC is implemented in custom integrated circuitry in PS/2s) and CMOS RAM is determined to be in working order, the POST sequence is started. The

Tutor

POST reads an ID code from each adapter plugged into the Micro Channel and compares it with the ID code recorded for that slot in CMOS RAM. If the two agree, the POST sends programmable configuration data to the card; if the IDs do not match, the machine beeps and displays an error code. The POST then proceeds as normal, but it will not boot the computer until the reference disk has been placed in the A: drive. The reference disk contains the configuration utility needed to resolve the conflict.

The POST varies in non-IBM BIOSs,

There's a high degree of uniformity among PCs in how the operating system is loaded.

but only to accommodate slight differences in hardware and to ensure that copyrights are not infringed upon. Similarly, there is a high degree of uniformity among PCs in the way the operating system is loaded because the bootstrap loader exists primarily in software, not in firmware.

It's difficult to trace through the actions of the power-on diagnostic and initialization routines without gaining a deeper appreciation for the complexity of the hardware and the delicacy of the interactions between components. And with appreciation comes understanding—the kind that may help you determine what went wrong the next time the POST reports an error.

ASK THE TUTOR

The Tutor solves practical problems and explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To have your questions answered here, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). We're sorry, but we cannot answer questions personally. ■

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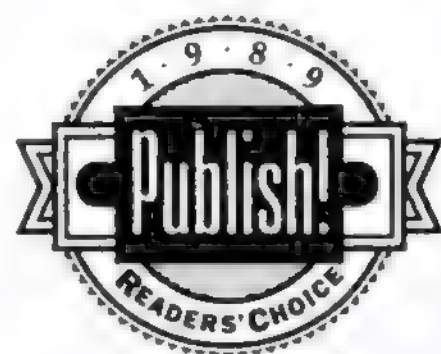
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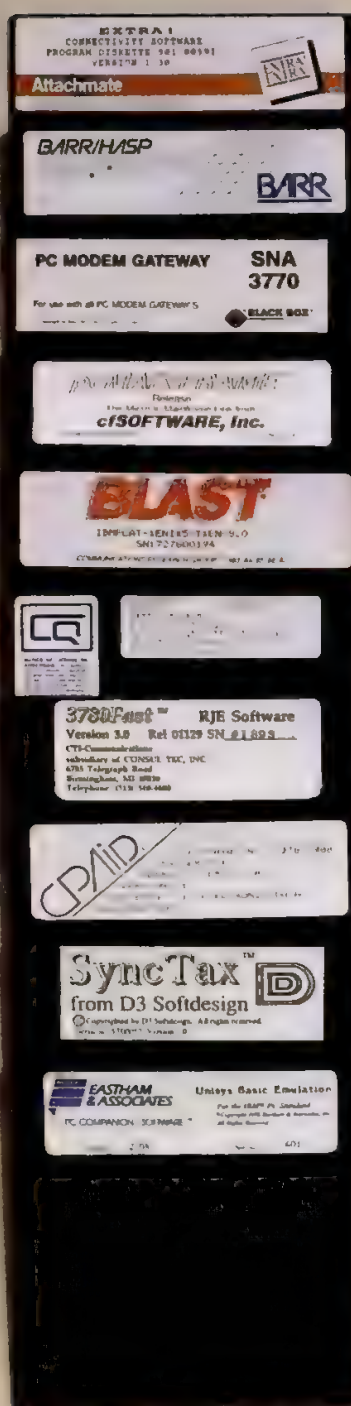
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by
Frank J. Derfler, Jr.

Connectivity Clinic

THE RESULTS ARE IN

In the May 30, 1989, column I offered our readers the opportunity to do a lot of work—and even risk their jobs—in return for a T-shirt. Over 170 of you took me up on the offer. Approximately one-quarter of the replies were from outside the U.S. and Canada. Managers from nearby Mobile and far away Melbourne, Florida, folks from Finland and Fiji, and integrators from Israel and India installed the accounting option on their Novell *NetWare* LANs and sent us at least a week's worth of detailed data describing their servers' activities. We also received replies from the Middle East, Australia, Korea, and Hong Kong, but none from Japan.

These folks were brave, because the Novell accounting system isn't well documented, and if you don't install it just right, you can lock all your users off the network—a potentially job-threatening situation. But the lure of a bright-red PC LAN Labs T-shirt from *PC Magazine* motivated 172 people to tackle the ticklish installation.

We gathered this information in order to calibrate the load provided by our LAN benchmark tests in terms of networked machines in the "real world." Benchmark testing is like economics: the experts argue endlessly over what the numbers mean, and anyone with an opinion is an expert. But our goal is to make some correlation between PCs running our LAN Labs benchmark tests and PCs running real-world applications on a network. At a minimum, this will provide more grist for the discussion mill, and we think it gives our readers a better gauge of network performance.

Here are some of the interesting things we learned. We were surprised to discover that our respondents had an average of 28 workstations per network. This is higher than we anticipated, but the figure was pushed up by some responses from multi-server networks with over 200 client stations. But even when we eliminated the highest three entries, the average only de-

■ **THE RESULTS ARE IN:** Many readers earned T-shirts, and we gained a better understanding of how our benchmark tests relate to real-world network activity.

■ **CHECKING FOR NEW MAIL:** Use this batch file to automatically check your mailbox.

■ **MULTIPLE CHOICE:** How to find a device that lets you use multiple CPU cards and a board that contains multiple modems.

■ **CONFLICTING INTERRUPTS:** Interrupt conflicts can disrupt communications.

creased to 24 workstations per network.

We were also surprised that, of the people who listed their most-common applications, over 50 percent specified word processing as their main network activity. What happened to all those networked databases and accounting systems that are supposed to be driving the industry? According to our survey, the primary output of networked computers seems to be words on paper.

The most common area of business for our respondents was banking. Many modern banks apparently use networks for administrative support. We also received replies from several state and federal court systems, numerous colleges and universities, and manufacturers of everything from athletic shoes to sewing machines. We heard from only one hospital.

Inspection of the connection-time statistics showed that the average client sta-

tion on a *NetWare* network stays logged in to the server 30 hours a week. This is partially because, once you are on the network, you can't unload the *NetWare* drivers from memory without rebooting. But the statistics indicate that the stations make heavy use of the network.

To make the correlation between our benchmark tests and real networked applications, we used information on the number of server requests per connected-station minute. The *NetWare* ATOTAL utility reports connected-station minutes under the heading of Connection Time. This is a cumulative number. If one station logs into the server for 60 minutes and another station simultaneously logs in for 30 minutes, the Connection Time entry is 90 minutes. This means that we don't have to worry about how many stations are on the network. Instead, we get a measure of how busy a given station makes the server. We need only look at the amount of work done per connected-station minute to get a rolling instant average.

We also learned that, on the average network covered by our survey, the server processes a total of 159 requests per connected-station minute. The reported numbers varied widely, from .2 to 3,740 requests per connected-station minute, but the average stayed around 150, even when we cropped off one standard deviation from the top and bottom of the distribution.

In comparison, we found that our PC LAN Labs benchmark tests, running in the Database Load mode, averaged 3,066 server requests per connected-station minute. This load was equaled or surpassed by only one real-world network in the survey. The number of requests per connected station dropped after we started the fourth station, indicating a backup in the queue for request services.

Based on nearly 200 samples, we can say that the PC LAN Labs benchmark tests load the network 20 times more than the average applications used on a network. Does this mean that one PC running our

Connectivity Clinic

loading test is the equivalent of 20 PCs running typical applications? Yes, on the average.

We are braced for arguments over the types of requests, how many are satisfied from cache, and the effects of different tests, but we are happy with the results.

These results have interesting implications for people buying and installing networks. They indicate that it isn't always necessary to have the superb performance of *NetWare 386* running on a 33-MHz CPU to have a network with adequate response time. Our tests, running on just two PCs, simulate 20 to 40 (pick any number you like in that range) machines in a typical network setting. Over the past few years, we've reviewed dozens of networks that give adequate performance when running our load tests on three to four PCs.

Thanks to your replies, we now have a much better understanding of how our benchmark tests relate to real-world network loads. Try to keep from attracting too many admiring crowds when you wear your LAN Labs T-shirts!

CHECKING FOR NEW MAIL

You can't use Novell's IF NEW_MAIL service outside of the log-in script. This means that you must constantly check your mailbox for new mail unless all memos to you are sent EXPRESS. However, you can check for new mail with a batch file.

Novell's mail system stores mail in a subdirectory identified by your mail ID. New mail is put into a file with the extension .IO. For example, if your ID is JACK, your mail is normally stored in \MAIL\JACK. New mail will be stored initially as \MAIL\JACK\JACK.IO. When you run MAIL, the subdirectory is cleared and your mail moves to \MAIL\JACK. Therefore, if any file with the

```
MAIL CHECK    COMPLETE LISTING
ECHO OFF
CLS
C:\WS\WS
F:
IF NOT EXIST \MAIL\JACK\JACK.IO
GOTO PASS
MAIL
:PASS
CLS
SYTIME
USERLIST
```

Figure 1: You can use this batch file to check *NetWare*'s mail.

extension .IO exists, that means you have received mail since the last time you used the MAIL function.

The batch file shown in Figure 1 lets you execute an application (WS for *WordStar* in this example) from your C: drive and then returns you to the network drive, F:, when you exit *WordStar*. If you've received any mail, the MAIL application runs automatically. If you haven't, the batch program bypasses MAIL and executes SYTIME and USERLIST. Of course, you can substitute any programs you like for the ones in this example.

Clinton W. Botkin
Hong Kong



The latest versions of *NetWare* no longer include Novell's MAIL utility, but this tip will be very useful to people running older versions. Other third-party electronic-mail systems include a TSR module that notifies users of incoming mail, but this will cost you some amount of RAM.

MULTIPLE CHOICE

In your July 1989 column you recommended J&L Products' Chatterbox, a device that allows you to put multiple CPU cards in a single cabinet. How can I get in touch with J&L? Can you also recommend a board that contains multiple modems?

W. Berry Ratliff
Ann Arbor, Michigan



There must be a lot of folks interested in a system like the Chatterbox, which can handle multiple roles on a network, such as an asynchronous communications server, a gateway, and a dial-in communications server. We've received many calls and letters asking for J&L's phone number. You can reach the company at (818) 709-1778.

For more information on the Chatterbox, see "Building Workgroup Solutions: Asynchronous Communications Servers" (*PC Magazine*, May 16, 1989). In that review we also described Omnitel's four-port serial modem cards. You can combine up to four of these cards on a single server to gain excellent internal modem capabilities. Phone Omnitel at (415) 490-2202.

CONFLICTING INTERRUPTS

We use Western Digital Ethernet cards on Dell System 200 PCs. Our network software is *NetWare*. Generally the network works fine, but sometimes a station loses its network connections before, while, or af-

ter someone uses modem software. We don't want to experiment with changing things too much, because we're afraid nothing will work. Do you have any ideas?

Benny Domingo
St. Petersburg, Florida



You have described a classic case of interrupt conflicts. I'll bet the problem appears only when the communications software addresses the second serial port, COM2, built into your Dell. COM2 uses IRQ 3. Novell's driver software for the Ethernet cards defaults to IRQ 3. Because of the type of hardware

You have described
a classic case
of interrupt conflicts.
COM2 uses IRQ 3,
and Novell's driver
software for
the Ethernet cards
defaults to IRQ 3.

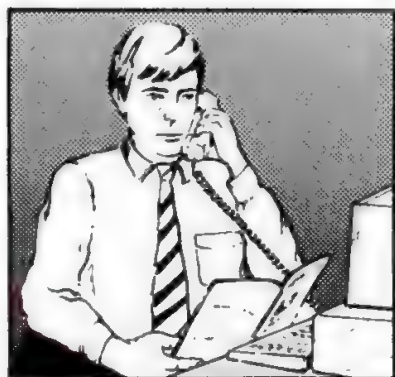
used in Western Digital's and Dell's products, they don't conflict until the serial port is addressed. You should try moving the communications device to COM1, or, if you don't want to lose the use of a serial port, move the Ethernet card and its Novell software driver to address IRQ 5. This interrupt should be free on the Dell PCs.

NETWORK YOUR QUESTIONS

Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay \$50 or more for any tips we print, *plus an extra \$25 if you submit your letter on a disk*. If you do, please include a printed copy. We'll gladly answer your questions at no charge, but we cannot answer letters personally. Mail contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). You may also contact Frank J. Derfler, Jr., via MCI Mail (use Derfler's box named CONNECTIVITY CLINIC). ■

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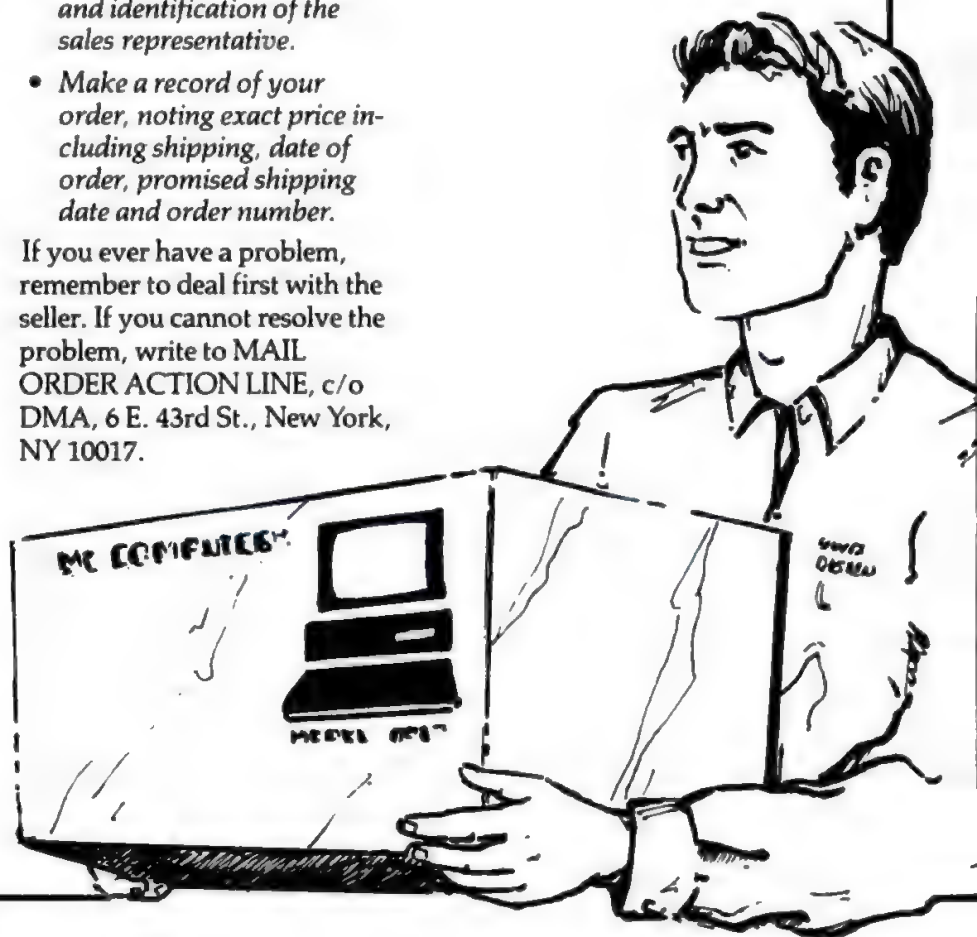
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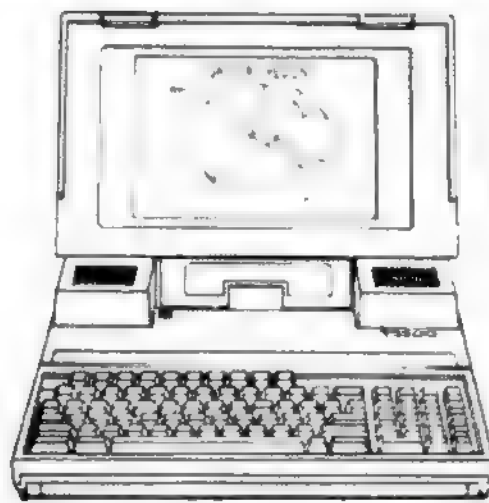
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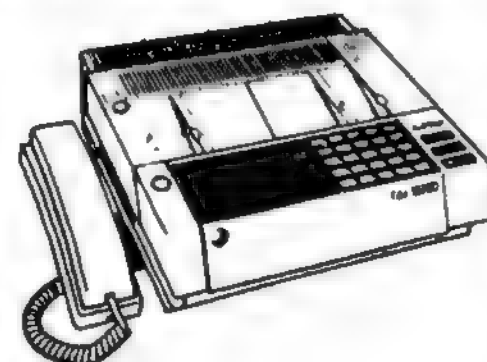
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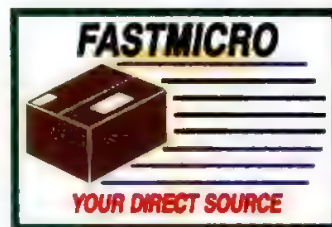
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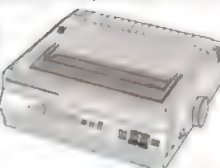
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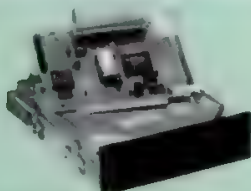
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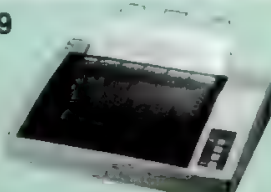
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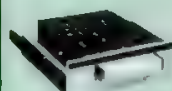
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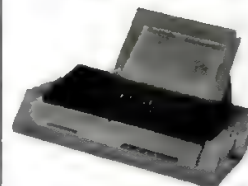
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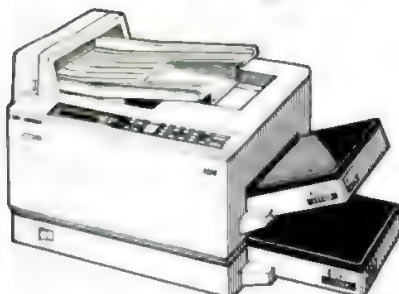
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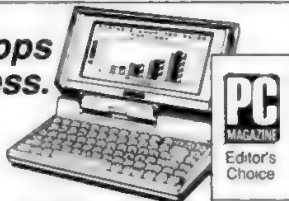
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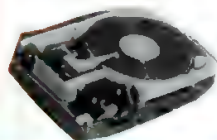
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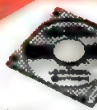
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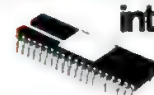
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PRODUCT CATEGORIES

HARDWARE

Add-On-Boards	355
CD-ROM	355
Cables	356
Communications	356
Computer Systems	358
Disk Drives	359
Diskettes	359
Expansion Units	360
Peripherals	360
Plotters	361
Power Supplies	361
Printers	361
Security	362

SOFTWARE

Accounting	362
------------	-----

SOFTWARE

Business	362
Bus. Proj. Mgmt.	363
Communications	363
Construction	363
Data Base	363
Data Entry	363
Desktop Publishing	364
Education	364
Engineering	364
Entertainment/ Games	364
Financial	364
Flowcharting	365
Graphics	365
Health	366
Inventory	366
Mailing Programs	366
Medical	366
Music	366
Preventative Maintenance	367
Programmers Tools	367
Public Domain/ Shareware	367
Real Estate	368
Religion	368
Sales Marketing	369
Scientific	369
Security	369
Statistics	370
Surveys	370
Taxes	370

Utilities	371
Word Processing	371

MISCELLANEOUS

Accessories	371
Bar Coding	372
Books/Catalogues/ Publications/	373
Computer Insurance	373
Data Conversion	373
Data Recovery Services	374
Disk Conversion	374
Diskette Copy Service	374
Supplies	374

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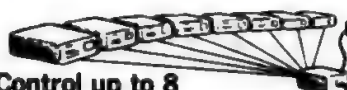
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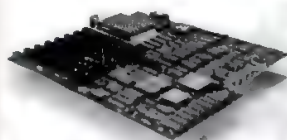
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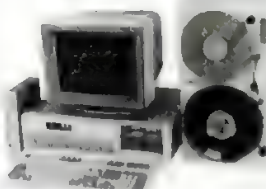
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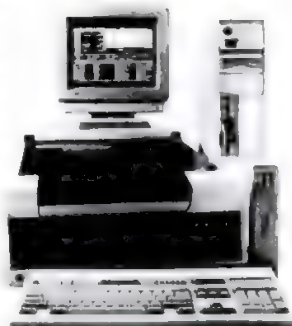
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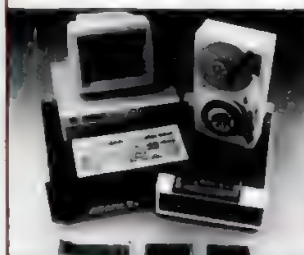
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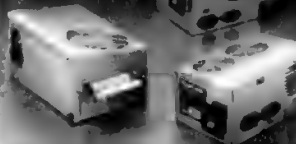
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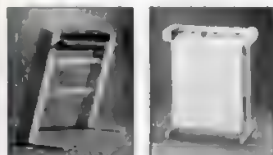
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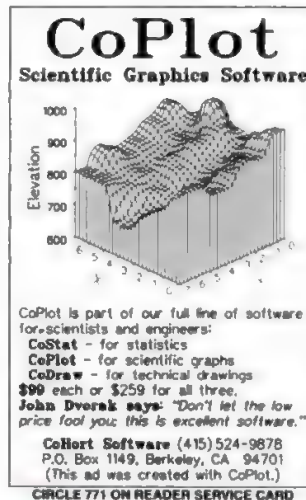
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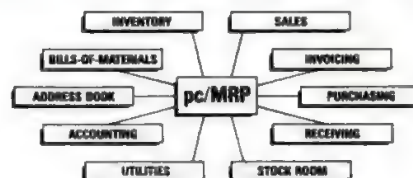
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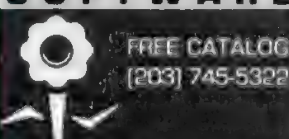
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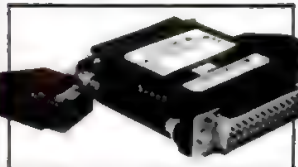
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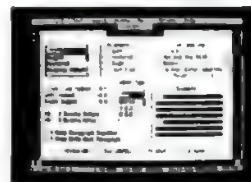
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- r. ☐ Mainframe(s) s. ☐ Mini(s)

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- u. ☐ In 4 to 6 months
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701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750
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1. In which of the following sectors does your organization operate? (Check one.)

- a. ☐ Private Industry
- b. ☐ Government
- c. ☐ Education

2. Your primary job function is (check one):

- d. ☐ MIS/DP, Communications Systems, Programming
- e. ☐ Engineering/R&D
- f. ☐ Finance/Accounting
- g. ☐ Marketing/Sales
- h. ☐ Administrative/General Management

3. Is your company a reseller?

- i. ☐ Yes j. ☐ No

4. For how many IBM PCs and compatibles do you specify brands of products?

- k. ☐ 10 or less
- l. ☐ 11-25
- m. ☐ 26-100
- n. ☐ 100 or more

5. Are there any PCs in your office? (Check all that apply.)

- o. ☐ Linked to mainframe
- p. ☐ Linked to mini
- q. ☐ Networked together

6. Does your company own

- r. ☐ Mainframe(s) s. ☐ Mini(s)

7. Do you plan to buy any PC products?

- t. ☐ Now
- u. ☐ In 4 to 6 months
- v. ☐ In 6 to 12 months
- w. ☐ No definite plans

8. Number of employees in your entire company?

- x. ☐ 25 or less 1. ☐ 500-999
- y. ☐ 26-99 2. ☐ 1000 or more
- z. ☐ 100-499

9. Are there any Macintosh computers in your office?

- 3. ☐ Yes 4. ☐ No

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■ LOW-END DESKTOP PUBLISHING

For the majority of users, a high-end desktop publishing product like *Aldus PageMaker* or *Ventura Publisher* is overkill for composing small newsletters and reports. Why pay for features you won't use? Low-end desktop publishing packages are finally producing documents you won't be embarrassed to claim as your own. PC Labs, teamed with contributing editor Luisa Simone, tests eight under-\$300 packages, including *PFS:First Publisher*, *Publish It!*, and *Finesse*, to show you what's evolved since we last reviewed this growing product area.

■ LCD PROJECTION PANELS

Desktop presentation is one of the hottest areas in the computer industry, but slide shows don't offer the real-time advantages available from LCD projection panels. These products, from companies like Eastman Kodak Co., Sharp Electronics Corp., and Computer Accessories Corp. plug into your PC or laptop and will project your ideas onto any wall or screen with the aid of a standard overhead projector. Less expensive than a film recorder and as light as a portable computer, LCD panels are the perfect on-the-road presentation devices.

■ DATA PROJECTION SYSTEMS

Using technology developed in the entertainment industry, data projection systems can project images 20 feet wide and wider. Their prices can reach into the six-digit range, but contributing editor Alfred Poor and PC Labs evaluate eight systems that list for under \$15,000. From companies like Electrohome, Sony, and Mitsubishi come the latest in high-quality data projection.

■ CD-ROM NETWORKING

Five products that provide multiple users with simultaneous CD-ROM access.



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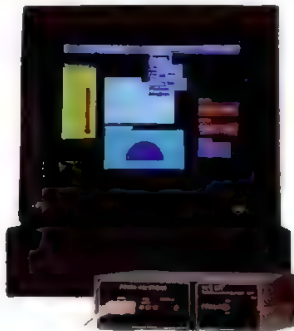
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July 18–September 25 Issue

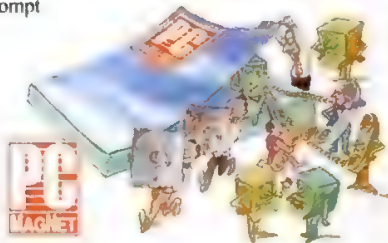
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After Hours

Products for the Leisure Side of Personal Computing

The Playroom Lets Children Advance at Their Own Pace

EDUCATION
by Robin Reskin

Ever watch a small child and a roomful of toys get acquainted? That same intensely busy, free-to-explore sensation is captured in Broderbund's latest game for the preschool crowd, *The Playroom*.

The Playroom's opening screen (a.k.a. main menu) is a colorful image of a child's bedroom filled with familiar objects: a bed, a toybox, a bookshelf, a window, a clock, and a radio. There are also some whimsical-looking creatures. Housed behind each static object is an animated activity or surprise. As children poke around (wielding joystick, mouse, or keypad) they become electronic explorers, charting their own course of play.

Some playroom objects trigger animated thrills. Selecting the window curtain causes Pepper Mouse (our game's protagonist) to reappear as a fire-breathing dragon. The bird-on-a-stand chirps, the goldfish somersaults, the radio plays a tune, and a desk drawer spits out a balloon that floats in midair and waits to be popped.

Six of the playroom objects (kids are quick to learn which) are gateways to full-fledged activities. Each has a different educational objective. Variations on the play reinforce the lesson, and each activity can be customized for an appropriate level of difficulty.

Selecting the clock object, for example, unearths a time-telling game. As your child clicks on various numbers on a large cuckoo clock, the passage of time is depicted in three ways: on the analog cuckoo, on a digital clock, and with words. Your child can

also watch Pepper Mouse enact an hour-appropriate activity and see the cuckoo bird spew musical notes as he chirps out the hour. Six o'clock becomes a concept with a relationship to the rest of the day.

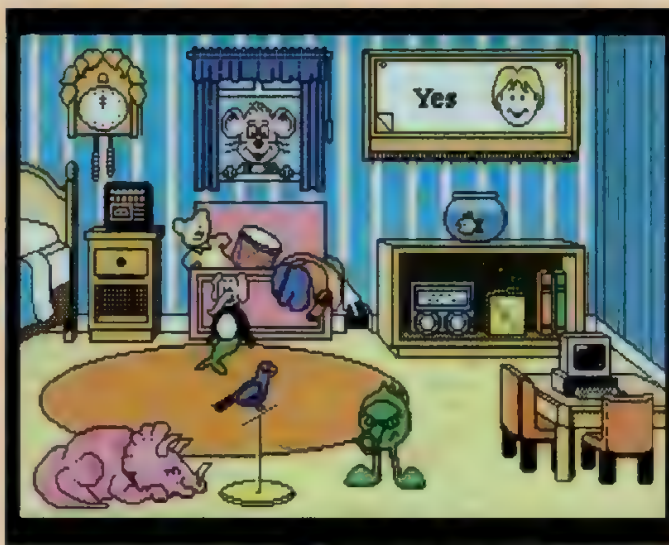
When your young explorer selects *The Playroom's* computer, he or she is shown a large animated computer designed to teach keyboarding and prereading skills. To warm up, your child selects random keys (on either the on-screen keyboard or your own keyboard) and watches the same letter appear on the animated computer screen.

When the sleeping Pepper

reinforced with a delightful animation. Pressing a wrong key generates clues. Those who have the optional Covox sound board get digitized phonics help.

The "Mixed Up Toy" game lets children mix and match body parts to create hilarious-looking combo creatures. A "Spinner" game shows two roulette wheels: one with numbers and one with pictures. As Pepper Mouse presents a number of objects in a display window, your child enters the correct number. Again, there are not only multiple levels of play, but also visual and auditory clues each time a mistake is made. Animation reinforces the right answer.

The "ABC Book" game is an electronic version of Colorforms. When your child selects a letter from the keyboard, a pic-



The Playroom's "main menu" is a colorful graphic of a child's bedroom. Surprises hide behind many of the objects.

Mouse is awakened, he displays 11 gift-wrapped items. Your child follows Pepper Mouse as he asks the youngster to type the word for each selected item, letter by letter. Each completed word is

ture of a word beginning with that letter appears. These pictures can be dragged and placed anywhere on one of two colorful backdrops, either a fairy-tale scene or a small neighborhood street.

EDUCATION
BannerMania prints signs in a big way

PERSONAL FINANCE
WealthBuilder by Money Maestro plans your investments

GAMES
Hosiaae: storm the embassy!

Unwanted objects can be dumped into the trash can (an icon worth getting familiar with).

The most complex of the games is "Mousehole." It's like a board game that teaches counting and has various levels depending on how high your child can count. Selecting an on-screen shaker causes animated dice to fall out and specify how many spaces to move. In this game one child can play against the computer, or two can play each other.

None of the games is terrifically novel. We've seen them all before, though never packaged in a grab bag, and never so finely tuned. The simplest games are easy enough to introduce to a three-year-old, but there's enough substance to keep eight-year-olds going for quite a while. My own kids seem

happiest when they're dragging a friend over to *The Playroom*, encouraging them to see how many games they can find and figure out.

CONTINUES

The Playroom

CONTINUED

Parents who fret about raising maladjusted computer nerds will appreciate Broderbund's integration of noncomputer activities. In Broderbund's now-classic *Carmen Sandiego* series, kids use a World Almanac to help solve the on-screen mysteries. Similarly, *The Playroom's* manual provides material for a variety of complimentary activities—from lotto and finger puppets to secret codes.

Of course, you'll want more. Any self-respecting, consumer/parent would. You'll wish the clock game could teach fractions of an hour. You'll wish the computer keypad let kids type in words, maybe even stories. You'll wish you could add spelling words of your own.

But *The Playroom* is onto some important stuff. All too often we teach our kids, very methodically, how to play. *The Playroom* encourages kids to play their own way. And the more kids (of all ages) see the computer as liberating instead of enslaving, the better off all of us will be.

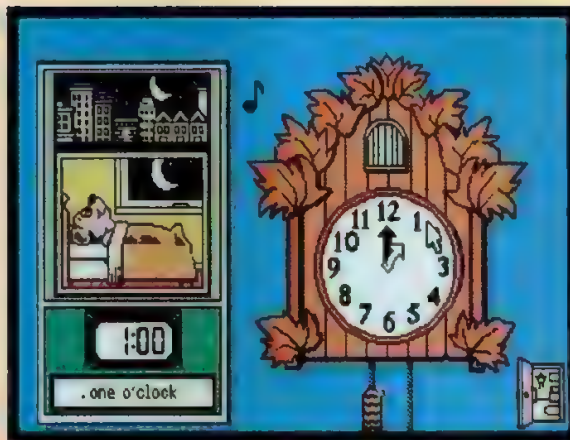
List Price: *The Playroom*, \$44.95. **Requires:** 512K RAM, graphics adapter, DOS 2.1 or later. Copy protected. Broderbund Software Inc., 17 Paul Dr., San Rafael, CA 94901-2101; (800) 521-6263, (415) 492-3533.

CIRCLE 542 ON READER SERVICE CARD

BannerMania: Express Yourself On a Large Scale

EDUCATION
by Luisa Simone

Many years ago—during my student days—I spent several feverish weekends completing a 35-foot banner for a type-design class. The Latin quotation, rendered in foot-high roman letters, was totally incomprehensible but (if I do say so myself) an impressive sight to behold. Broderbund's \$34.95 *BannerMania* takes what I recall to be an enormous effort and



Concepts such as time are taught by *The Playroom's* numerous games and puzzles. Children proceed at their own pace.

reduces it to child's play.

BannerMania steps you through the process of creating a sign. Choosing the typestyle, special effects, colors, and an overall banner shape is as effortless as scrolling through a series of self-explanatory menus. As your cursor moves through the various options, a preview window gives you instantaneous feedback. At any point you can see a full-size, full-color version of your poster advance across your monitor simply by hitting the F2 key.

BannerMania supplies 19 fonts that are anything but business-like. Along with 28 dingbat characters (accessed with control-key combinations), these fonts really jazz up your messages. *BannerMania* assumes that you want the type to print as large as possible, and so you are never asked to specify point sizes. All of the typefaces, however, can be transformed with special effects that range from perspective rendering to blending and outlining.

One particular menu choice, Transmogrify, is pure entertainment. You simply watch as different typestyles, colors, and special effects are randomly applied to your message. The serendipitous results range from the merely dramatic to the totally wacky, and can be saved, printed out, or used as the basis for further modification.

Novices will be grateful for the helpful limitations that make

it almost impossible to screw up a design, but more-advanced users may find it frustrating to attempt to bypass the program's restrictions. For example, predetermined color/pattern sets ensure that your banner is (almost) never garish and always legible. But even when you opt to create custom coloring schemes, you cannot color the letters individually—changes apply to the entire line of text.

Similarly, you must chain banners together at printout time to work around the 63-character per line limit. And you must use the stretch function to effect the illusion of larger characters; in truth you can only decrease (not increase) the character height.

BannerMania really shines at printout time. Intelligent support for sheet-feed printers leaves a quarter-inch "seam" to help piece the banner together. There is even an option for mirror-printing iron-on T-shirt transfers. And single-, double-, or triple-pass printing ensures that color dot matrix output will have rich hues even with a worn ribbon. But be warned: a large banner (10 letter-size pages) took one and a half hours to print out on an Epson LQ-2550.

I did encounter one minor glitch: although the banner printed just fine on an HP LaserJet, the bottom corners were missing on the Epson color printout. Broderbund's only suggestion was to reduce the overall banner size on a trial-and-error basis until the corners printed.

I would add a print-to-disk option to the output menu, which would make it possible to design a banner (with the correct printer drivers) at home and produce hardcopy on the high-resolution or color printer at the office. But even without this small improvement, *BannerMania* is an excellent value that encourages us all—artist, novice, and child—to express ourselves in a big way.

List Price: *BannerMania*, \$34.95. **Requires:** 256K RAM, graphics adapter, DOS 2.1 or later. Broderbund Software Inc., 17 Paul Dr., San Rafael, CA 94903-2101; (800)-521-6263.

CIRCLE 543 ON READER SERVICE CARD



You can preview your banner from within any menu by hitting the F2 key. The program even simulates the perforations on continuous-feed paper.

INDEX TO ADVERTISERS

RS #	ADVERTISERS	PAGE	RS #	ADVERTISERS	PAGE	RS #	ADVERTISERS	PAGE
485	Acma Computers, Inc.	40-41	305	Hewlett Packard Peripheral Group...	206-207	169	PC Designs	20
118	Advanced Computers Inc.	347	491	Hewlett Packard Peripheral Group...	234-235	497	PC Magnet	346
281	American Power Conversion Corp.	228	143	Intel	293	140	PC Publishing	147
336	Arlington Computer Products	340	142	Intel	47	358	Peachtree Software	221
472	Ashton Tate	179	512	Intel	160	302	Peter Norton Computing	300
176	ask Sam Systems	92	*	Intuit Software	29	141	Personics Corp.	56
738	AST Research	103	325	I.Q. Engineering	143	148	Primavera Systems	59
307	AT&T Data Systems Group	281	219	Irwin Magnetics	176	259	QMS	5
509	Austin Computers	10-11	179	Jameco	342	221	Quill Corp.	304-305
736	Autodesk	124	114	Kelly Temporary Services	302	195	Raster Devices Direct	243
204	Avery	159	*	Kensington Microware Ltd.	82	192	Raster Devices Direct	245
119	Baler Software	313	492	KYE International	325	290	Rose Electronics	226
*	Bloc Publishing	68	178	Lahey Computer Systems	291	295	RP Systems	337
377	Borland International	55	*	LAPTOS PLUS	336	349	S&W Computers	353
147	Borland International	57	280	LaserGo Inc.	4	*	Scitor Corporation	181
481	Bulldog Computer Products	352	*	Lotus Development Corp.	152	184	Shamrock	341
273	Bus Computer	345	263	Macola Inc.	310	110	Sharp Electronics Corp.	225
494	Buttonware	292	154	MathSoft Inc.	326	279	Sigma Data	353
144	Calcomp	288-289	*	Maxell	9	393	Software Link	42
471	Canon USA Inc.	224	150	Metheus Corporation	223	*	Software Publishing	129
749	Central Point Software	62	225	MicroWarehouse	172-174	900	Soyo USA	382
318	Chinon	296	*	Micrografx	66	161/314	Storage Dimensions	130
*	Compaq Computer Corporation	209-216	*	Microsoft	322	365	STSC	127
*	CompuAdd	94-95	*	Microsoft	2-3	299	SWFTE International LTD	37
*	CompuAdd	248-251	*	Microsoft	186	289	Tandy Corp.	65
226	Compuserve Information Service	246	331	Microway	90	294	Tatung	151
*	Computer Associates	144	489	Midwest Computer Works	344	123	Telemart	86-87
*	Computer Associates	219	368	Mitsubishi Electronics	167	206	Telemart	88-89
109	Computer Discount Warehouse	351	240	Mountain Computer Inc.	26	*	Texas Instruments	121-123
163	Computer Products United	76-77	170	Multisoft	220	*	Texas Instruments	60-61
729	Corel Systems	49	153	NEC Home Electronics Inc.	C2-C4	*	TOPS	282
278	Crosstalk Communications	284	*	NEC Home Electronics Inc.	1	162	Toshiba of America	119
*	Curtis Manufacturers	101	217	Next Computers	18-19	231	Touchbase Systems	28
*	Dac Easy Inc.	69	*	Northgate Computer Systems	269-271	223	Traveling Software	276
483	Damark International	343	*	Northgate Computer Systems	308-309	121	Tri-Star Computer	17
504	Datastorm Technologies	222	*	Northgate Computer Systems	278-279	735	Triton Technologies	84
*	Dataworld	158	*	Northgate Computer Systems	321	268	Tussey Computer Products	22-25
536	Dell Computer Products	C5-C8	*	Northgate Computer Systems	240-241	251	Ultra Comp	39
527	Dell Computer Products	191-193	*	Northgate Computer Systems	52	367	Universal Data Systems	332
256	Delta Technology	14	374	O'Neil Communications	32	272	Viewperfect System	227
243	DSC Communication	149	362	OCR Systems	331	171	Warehouse Data Products	294-295
102	DTK Computers	155	235	Okidata	188-189	*	Wordperfect	96
347	Dustin Discount Software	78	168	Olivetti	81	199	Xtree	185
152	Emerson Electric	45	*	Oracle	74	518	Xyquest	318
*	Epson	170-171	241	Pacific Data Products	165	139	Zaki Corp.	21
216	Everex Systems, Inc	12-13	342	Pan Overseas Technologies	58	388	Zeos International	141
352	FASTMICRO	338-339	138	Panasonic Computer Division	106-107	269	Zeos International	70-71
288	Fifth Generation	239	271	Pao-Ku LTD	349	*	Zeos International	133-140
232	Fifth Generation	50	151	Parsons Technology	93	721	Zeos International	30-31
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506	Generic Software Inc.	314	309/304	PC Brand	258-259			
*	Hard Drives International	348	310/311	PC Brand	260-261			
201	Haventree Software	80	*	PC Brand	262			
167	Helix Software	85	*	PC Connection	198-203			

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thBuilder Money Maga- zie Plans Your Deal Investment Strategy

PERSONAL FINANCE
by Winn L. Roach

If you have cash to invest in Wall Street but your knowledge of bulls and bears is limited to what goes on in china shops and the woods, *WealthBuilder* by Money Magazine was written for you. A combination financial planner and investment counselor, the \$245.95 program from Reality Technologies dispenses solid advice aimed primarily at helping the already-affluent become more so.

WealthBuilder stands out among financial programs because its focus is long range rather than day to day. It deals in what you should do instead of what you've already done. While it won't keep books or write checks, it will help you organize your financial plans, set goals, and find ways of achieving them by picking the perfect portfolio of stocks, bonds, and mutual funds.

You start building your wealth with *WealthBuilder*'s FactFinder, a template. You type your vital statistics—who you are, what you own, and what you owe—into the program's personal balance sheet. To indicate the risks you're willing to take, you judge your investment temperament on a thermometer scale that runs from conservative (a money-belt

is your best friend) to aggressive (put it all in penny stocks).

You start your plan for the future with *WealthBuilder*'s Objectives section. Using a nested set of annotated spreadsheet screens, you indicate one or more financial goals—saving for a house, your children's college, or retirement—and how you think you can achieve them.

Based on these preliminaries, *WealthBuilder* helps you set up a solid financial plan using its Strategy section. Here you'll figure out the best budget for your savings. Among other things, you'll discover that living well in your old age requires a nest egg that would dwarf what the biggest dinosaur could lay—likely \$1 million or more. *WealthBuilder* takes care of all the mathematics and allows for present values and inflation.

Once you've set your savings budget, *WealthBuilder* recommends how you should invest it by creating a personal asset-allocation model based on

your income, assets, and willingness to take risks. It suggests dividing your investment pie into optimum slices allotted to stocks, bonds, precious metals, and cash (bank accounts).

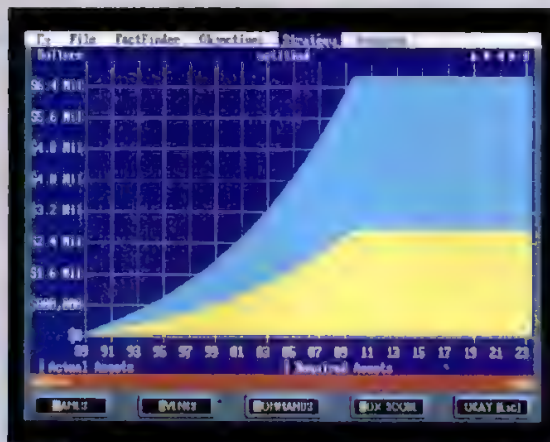
The asset-allocation model promotes diversification, so you avoid putting that big nest egg into only one basket. Follow the model and you can balance your investments against inflation, plunging markets, and the worst twists of fate.

It's a sound strategy. Historically, 90 percent of all professional money managers who try to "time" their investments by buying low and selling high actually underperform the market, according to Reality Technologies. On the other hand, a good portfolio mix held long-term can match or beat the market average.

Of course, market conditions change all the time, and *WealthBuilder* runs the chance of becoming quickly outdated should the economy sweeten or

sour. Because the assumptions made by any asset-allocation model must stay in line with reality, *WealthBuilder* is designed to adapt to such changes (and incidentally hook you into a long-term relationship with Reality Technologies) with quarterly updates priced at \$99.95 per year. You can also tinker with some of the assumptions by adjusting the program's default settings.

WealthBuilder plans a savings and investment scheme that will meet your goals. The program tracks your progress graphically.



WealthBuilder shines brightest where other financial-planning programs fade out. *WealthBuilder* does not simply tell you to buy into equity or debt instruments; in addition, it helps you to find the best stocks and bonds to invest in.

In its Product section, *WealthBuilder* offers you guidance in the form of a database that offers information on 400 mutual funds. Send in your registration card and you'll get a 1,000-fund update. Version 1.1 of

WealthBuilder, which should be available by the time you read this, adds an equivalent dose of data on stocks and bonds. The quarterly updates also add the latest financial performance information on the stocks, bonds, and funds in the *WealthBuilder* database.

While *WealthBuilder* won't predict market peaks or pick the best instant to sell short, it will help you match particular funds to your investment objectives by showing you statistical and graphical comparisons of fund performance stretching back as far as ten years.

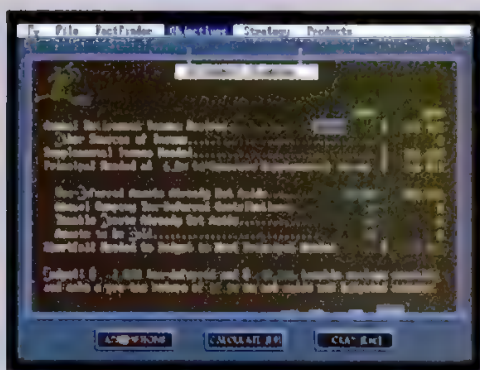
WealthBuilder assumes that you know no more about your personal computer than you do about the Chicago spot market or Duncan's Ritual. You control the software through simple drop-down menus. In order to help break the ice, *WealthBuilder* includes a quick quiz game that wouldn't strain even Vanna White's brain, a tutorial, and a handful of canned case studies.

WealthBuilder by Money Magazine gives practical, sound, conservative advice. While it won't make you immediately rich, it can make you a smarter investor, one who builds himself a secure future.

List Price: *WealthBuilder* by Money Magazine, \$245.95; four quarterly updates, \$99.95.

Requires: 512K RAM, 3.8MB hard disk space, DOS 2.0 or later. Reality Technologies Inc., 3624 Market St., Philadelphia, PA 19104; (800) 346-2024, (215) 387-60551.

CIRCLE 544 ON READER SERVICE CARD



WealthBuilder starts you down the road to financial security by first helping you analyze your goals and telling you how to reach them.

After Hours

Hostage: You Save A U.S. Embassy from Terrorists

GAMES
by Don Trivette

Highly trained marksmen took up positions outside the embassy today, as an assault team rappelled down from the roof and crashed through a window. Once inside, the team of three commandos located the hostages and led them to a safe room on the third floor. Casualty reports are incomplete, but a number of terrorists are confirmed dead.

The six o'clock news? No. This is *Hostage*, an action game from Mindscape. As the lieutenant in charge of the operation, your job is to rescue hostages from an overrun embassy. At your command are six men with

code names Delta, Echo, Mike, Hotel, Tango, and Bravo. You control each of the six individually and can switch from one to another simply by pressing a corresponding function key.

The rescue is made in four stages: surrounding the building, rappelling from the roof, finding the hostages and subduing the terrorists, and reviewing the results. If there's anything wrong with *Hostage*, it is that the briefing booklet gives away too much. It tells you where to station your sharpshooters and how

to secure the hostages. But the doing is more difficult than the telling. There are lots of little things the book doesn't tell you.

Once you are inside the building, a small diagram on the screen shows where hostages, terrorists, and your own men are positioned; the greater part of the screen presents a three-dimensional view through the eyes of the man you are controlling. You work your way from room to room, blasting terrorists and collecting hostages one at a time. But even after the hostages are

secured in the windowless room on the third-floor, you've got to keep an eye out lest a stray terrorist sneak in and waste every body.

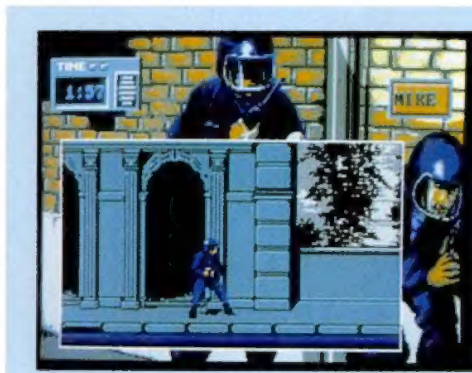
There are five levels of play, ranging from Training to Assault; each of these may be played as Lieutenant, Captain, or Commander, giving you a total of 15 different scenarios. You begin at the lowest rank and work your way up by successfully completing the mission, at which time you are awarded a promotion and a password that lets you play future games at a higher rank. I'm still playing as a Lieutenant although several of my friends have made Captain.

Hostage appears to be a harmless little game, but gamers beware: somehow you just can't put it down until everyone is safe. ■

List Price: *Hostage*, \$39.95.

Requires: 512K RAM, CGA or EGA graphics, DOS 2.1 or later. Copy protected through documentation. Mindscape, 3444 Dundee Rd., Northbrook, IL 60062; (312) 480-1948.

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—Semyon Roitman, President, Entre Computer Store

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CIRCLE 158 ON READER SERVICE CARD

Abort, Retry, Fail?

The Lighter Side of Personal Computing

AMAZING FACTS

Dictionary: Byte

"IBM told a packed crowd in New York that one day Micro Channel will be able to transfer 160 million bytes of data per second—that's eight times faster than its current speed. (A byte represents eight letters or numbers)."

—USA Today

Not Everyone Can Tell the Difference

"The standards for displays have again been revised, albeit only slightly, by the introduction of the Multi-Color Graphics Array (MCGA) for IBM Personal System/2 Models 25 and 30 and the Video Graphics Array (VGA) for IBM PS/2 Models 50, 60, and 80. The MCGA is similar to the CGA but has higher resolution. (The MCGA's resolution is 320 x 400; the CGA's is 320 x 400.)"

—DOS Programmers Reference by Terry R. Dettman (Que Corp., 1988)

In a Manner of Speaking

"The [Friday the 13th] virus failed to appear in Canada, though it did strike elsewhere."

"In London, the Royal National Institution for the Blind was one of the hardest hit as the virus wiped out months of work."

"Every time we try to look at a new program file it vanishes in front of our eyes," said spokesman Corri Barrett."

—Financial Post, October 16, 1989

For Details, See "Reference, Circular"

"Excel supports 80386 microprocessors, high-resolution monitors, and laser printers. It works with other spreadsheets, including Lotus 1-2-3, MultiPlan, and Excel."

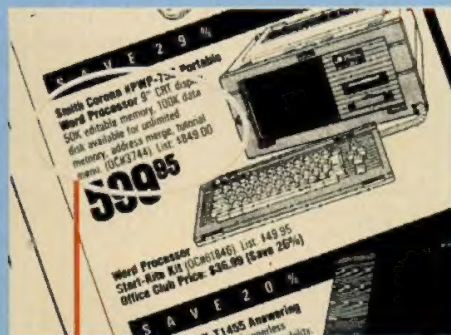
—LAN Times Product Focus, October 1989

AMAZING FACTS

Just like the LaserJet: You Adjust Output Quality with The Dial Marked "Rare-Medium-Well Done"

"The [DTM Corp. 3-D] printer is based on a technology called selective laser sintering, which uses laser beams and a special powder to mold three-dimensional machine parts, much like conventional laser printers burn letters onto a page."

—Austin American Statesman, October 31, 1989



100K floppies equal "unlimited memory"?

That's the claim of this Office Club ad in The (Portland) Oregonian, October 26, 1989

We Suspect This Article Was Written on a Mac

"Even with Macs, students will be using a machine found in less than 15 percent of the nation's offices. If schools wanted to provide their students computer training that would be immediately useful in a business setting, they would install a battery of MS-DOS machines and start teaching kids what to do when they see the infamous 'C' prompt: C<."

—Personal Computing column, The Washington Post, October 9, 1989



Useful if You Continually Forget Names and Birthdays

"Environment: Releases the environment upon loading of LaserTORQ. Useful for people with severe memory limitations because it frees approximately 256 bytes of DOS memory."

—Command summary, LaserTORQ Owners Manual

PC Magazine offers \$50 and a PC Magazine T-shirt if we use your submission in Abort, Retry, Fail? Winners this issue: Peter Grasmuck (virus attacking the blind); Robert Clark (burning lasers); Pascal O.

Desmarests (self-compatible Excel); Russ Khonry (memory limitations); Daniel Szott (1 byte equals 8 characters); C. Douglas Welty (backwards C prompt); David D. Lutjen (unlimited memory); Daniel Ben-Ezri (MCGA vs. CGA).

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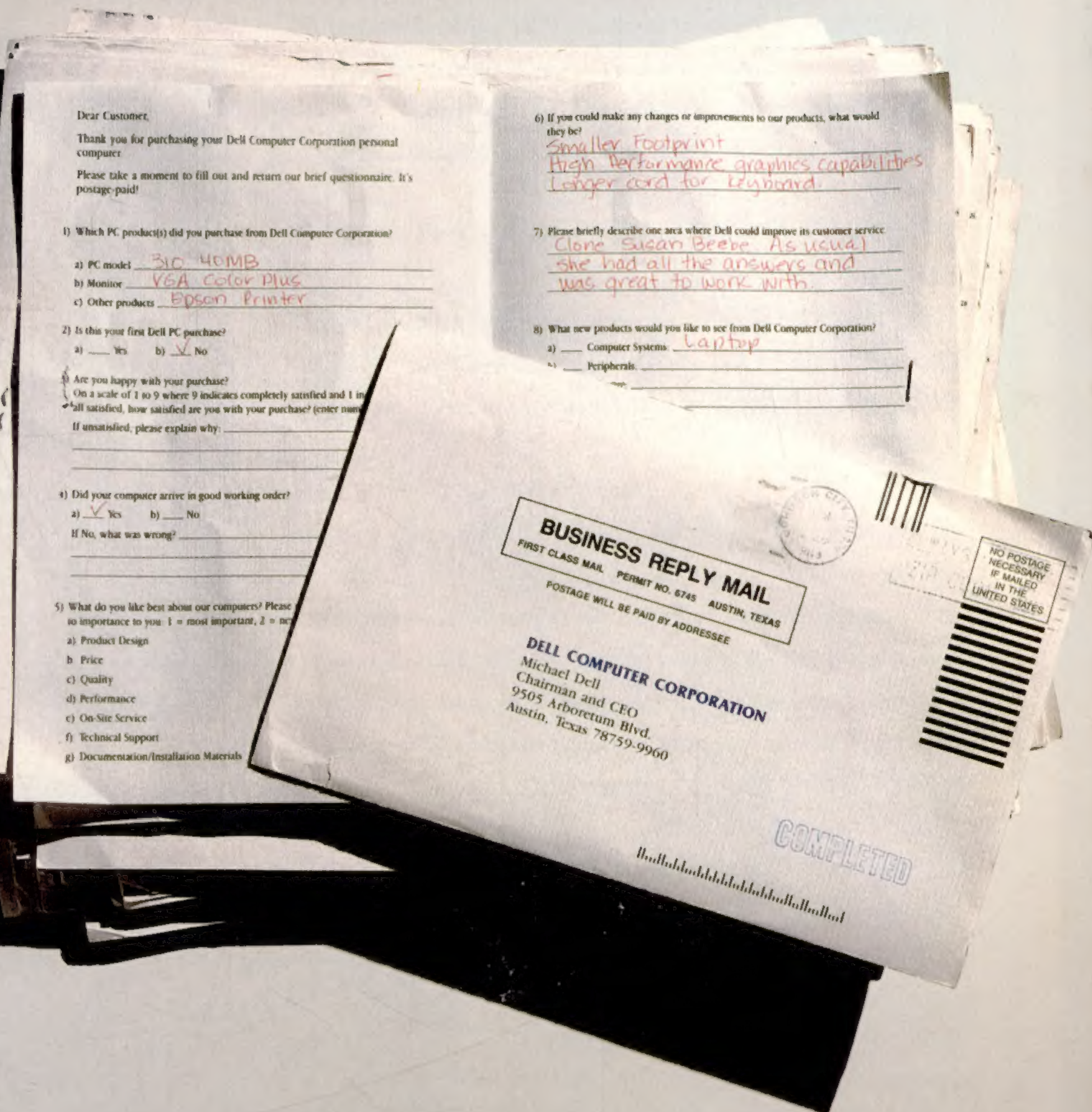
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